OPERATING AND MAINTENANCE MANUAL

MODEL 1018 B

LOG/LIN RF PEAK POWER METER

MODEL 1018B

WAVETEK MICROWAVE, INCORPORATED

SUPPLEMENTARY DATA

MODEL 1018B/02 SPEC 5355-004

This Model 1018B/02 RF Power Meter is a standard unit which has been modified to provide a detector input cable of 4 meters in length.

REV	A	
ECO	PROD REL	
DATE	07-10-91	
SHEETS AFFECTED	ALL	

ORIG Dan Watson	DATE 07-10-91	QA Tim Lane	DATE 7-11-91
ENG Dan Watson	07-10-91	MKTG Carol Citron	7-11-91
MFG Tim Lane	07-11-91		

WAVETEK
MICROWAVE, INCORPORATED
SUNNYVALE, CA

DOCUMENT NO.	16956-S5355-004
SHEET NO. 1	CONT. ON 1
LAST REVISED (DATE)	07-10-91

WAVETEK MICROWAVE, INCORPORATED

SUPPLEMENTARY DATA

MODEL 1018B OPTION 02

This instrument is equipped with a crystal detector that has an APC-7 input connector.

SPECIFICATIONS

All standard specifications apply except as noted below:

VSWR:	1.3 from 12.4 GHz to 18 GHz
Input Connector:	APC-7

MODIFICATION

1. Detector Assembly A9 has been replaced with a unit that has an APC-7 input connector.
2. CALIBRATOR OUTPUT connector J9 has been changed to mate with the detector connector.

REPLACEABLE PARTS LIST

Circuit Ref.	WPM Part No.	Description
J9	12138	Connector, Type APC-7
A9	14901*	Detector Assembly Replacement Kit
A9CR1	14904*	Diode Replacement Kit

* Denotes units with Code 12 - up.

WAVETEK MICROWAVE, INC.

SUPPLEMENTARY DATA

ISOLATED BCD INTERFACE FOR 3-1/2 DIGIT DISPLAY

This instrument is equipped with additional circuitry providing digital display information in BCD form at a rear panel connector. The following signals appear on the terminals of a 24 pin connector:

1. Thirteen lines of numerical data in binary coded decimal form.
2. One line "POLARITY".
3. One line "DATA READY".
4. Data I/O Common (not tied directly to chassis ground, but connected through an RF bypass capacitor.)
5. Chassis ground.
6. "TRIGGER RESET" input.
7. "TRIGGER" input.
8. Trigger reset input/Trigger input common (tied to chassis ground and by an RF bypass capacitor to Data I/O Common.

SPECIFICATIONS

Logic Levels:	TTL logic levels
One	> 2.4V at 0.5 mA
Zero	< 0.4V sinking 16 mA
Data Format:	A logical one implies true data. A logical one implies + polarity. A logical one implies 'data ready'.
Conversion Period:	Approximately 1.5 ms. Following the arrival of a trigger, a logical zero will appear on the "DATA READY" line for a period not exceeding 500 μ s. At all other times the line will be at a logical one.

Therefore, the positive-going edge of "DATA READY" indicates that new data is available on the output lines. The data will remain valid until "DATA READY" goes false.

Trigger and Trigger Reset:

A 0.2 μ s positive pulse will reset the trigger circuit. The "TRIGGER" and "TRIGGER RESET" inputs are coupled to the instrument through pulse transformers. Normally these inputs respond to the rising edge of pulses supplied to them.
To cause the "TRIGGER RESET" input to respond to the descending edge of the pulse, reverse the leads to A6-27 and A6-28. To cause the "TRIGGER" input to respond to the descending edge of the pulse, reverse the leads to A6-3 and A6-4.

Output Connector:

24 Pin Amphenol #57-40240.

DIGITAL DATA OUTPUT CONNECTOR PIN ASSIGNMENTS

Function	Pin Number	Function	Pin Number
BCD 0.01	15	BCD 4	5
BCD 0.02	14	BCD 8	4
BCD 0.04	13	BCD 10	3
BCD 0.08	12	POLARITY	1
BCD 0.1	11	DATA READY	2
BCD 0.2	10	TRIGGER RESET INPUT	20
BCD 0.4	9	TRIGGER INPUT	16
BCD 0.8	8	TRIGGER/TRIGGER RESET Common	18
BCD 1	7		
BCD 2	6	Data I/O Common	17
		Chassis Ground	19
		Not Used	21-24

ACCESSORY

The following accessory is provided:

Quantity	Part Number	Description
1	10757	24 pin cable connector Amphenol # 57-30240

MODIFICATION

The following modifications have been made to the standard instrument:

1. A 24 pin connector has been added to the rear panel.

2. Interface PC Board assembly 13501 has been added above the digital assembly A7.

INSTRUCTIONS FOR THE PREPARATION OF AN INTERCONNECTING CABLE

In order to provide for the maximum flexibility of application, the digital output common line (signal return) does not have a dc connection to chassis ground. If it if desired that the common line remain isolated, only pin 17 should be cabled as a common line to the rest of the system. Alternatively, to connect the output to the chassis, pins 17, 18, and 19 should all be connected together with their common line to the rest of the system. In general, it is best to connect these pins together if possible, as there is less possibility of unwanted noise when this is done. In all cases, pin 19 may be used as a means of connecting to the metal chassis to secure a protective ground to the system.

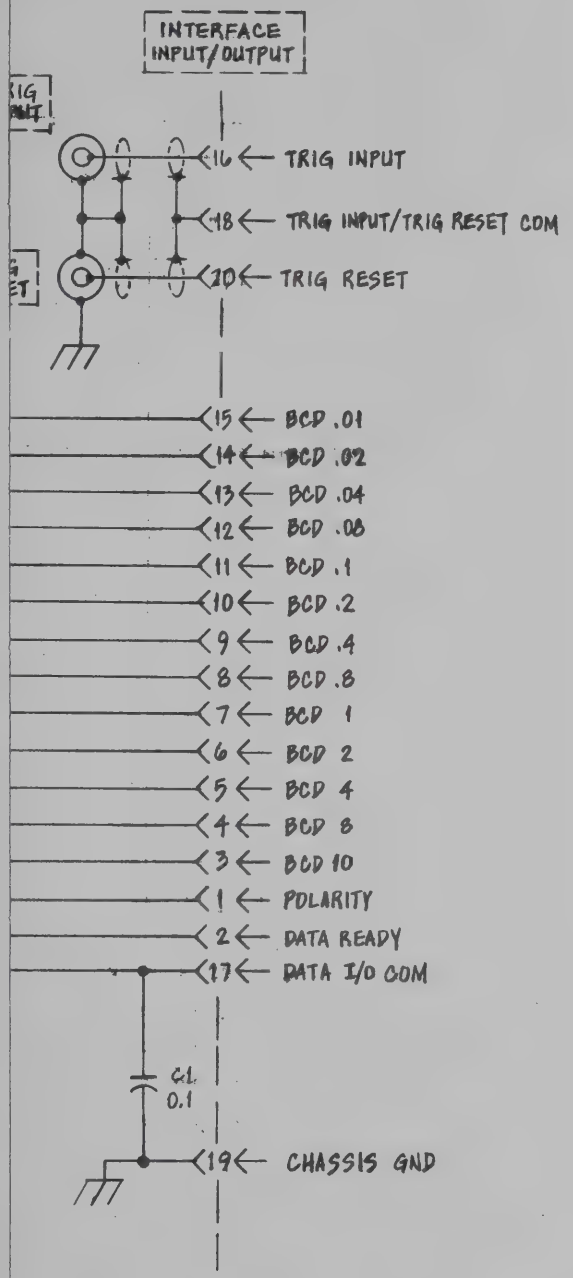
REPLACEABLE PARTS LIST

CIRCUIT REFERENCE	PART NO.	DESCRIPTION
C1	10000-10	Ceramic 0.1 μ F +80% -20% 10
J1	10758	Connector 24 Pin, Amphenol 5
A15C1	10787-10	Tantulum 100 μ F ±20% 20 V
A15C2	10003-3	Electrolytic 4000 μ F 15 V
A15C3	10000-10	Ceramic 0.1 μ F +80% -20% 10
A15CR1	12409	Rectifier, Full Wave Bridge
A15R1	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A15R2	10013-41	Carbon Film 22 KΩ ±5% 1/4 W
A15R3	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A15R4	10013-41	Carbon Film 22 KΩ ±5% 1/4 W
A15R5	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A15R6	10013-41	Carbon Film 22 KΩ ±5% 1/4 W
A15R7	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A15R8	10013-41	Carbon Film 22 KΩ ±5% 1/4 W
A15R9	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A15R10	10013-41	Carbon Film 22 KΩ ±5% 1/4 W
A15R11	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A15R12	10013-41	Carbon Film 22 KΩ ±5% 1/4 W
A15R13	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A15R14	10013-41	Carbon Film 22 KΩ ±5% 1/4 W
A15R15	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A15R16	10013-41	Carbon Film 22 KΩ ±5% 1/4 W
A15R17	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A15R18	10013-41	Carbon Film 22 KΩ ±5% 1/4 W
A15R19	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A15R20	10013-41	Carbon Film 22 KΩ ±5% 1/4 W
A15R21	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A15R22	10013-41	Carbon Film 22 KΩ ±5% 1/4 W
A15R23	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A15R24	10013-41	Carbon Film 22 KΩ ±5% 1/4 W
A15R25	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A15R26	10013-41	Carbon Film 22 KΩ ±5% 1/4 W
A15R27	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A15R28	10013-41	Carbon Film 22 KΩ ±5% 1/4 W
A15R29	10013-19	Carbon Film 330 Ω ±5% 1/4 W
A15R30	10013-41	Carbon Film 22 KΩ ±5% 1/4 W

REPLACEABLE PARTS LIST

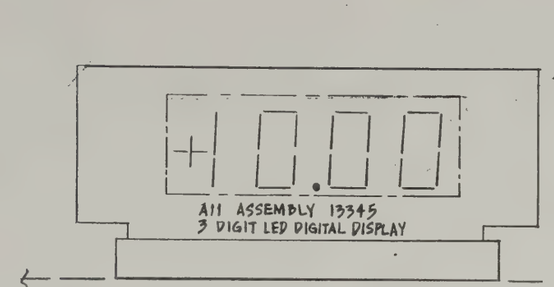
CIRCUIT REFERENCE	PART NO.	DESCRIPTION
A15S1	12430	Switch, Slide DPDT
A15U1	11270-34	Integrated Ckt SN7407N
A15U2	13476	Integrated Ckt MCT-6 (Monsanto)
A15U3	13476	Integrated Ckt MCT-6 (Monsanto)
A15U4	13476	Integrated Ckt MCT-6 (Monsanto)
A15U5	11270-34	SN7407N
A15U6	13476	Integrated Ckt MCT-6 (Monsanto)
A15U7	13644	Integrated Ckt HP5082-4354
A15U8	13644	Integrated Ckt HP5082-4354
A15U9	13470-4	Integrated Ckt SN74LSO4N
A15U10	13476	Integrated Ckt MCT-6 (Monsanto)
A15U11	13476	Integrated Ckt MCT-6 (Monsanto)
A15U12	13569	Integrated Ckt DM 8097
A15U13	13569	Integrated Ckt DM 8097
A15U14	13569	Integrated Ckt DM 8097

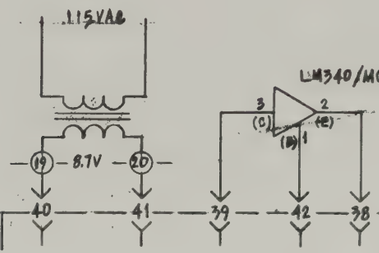
SYM	REVISION	ECO	DATE

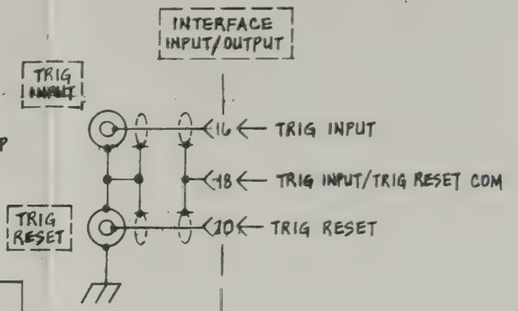


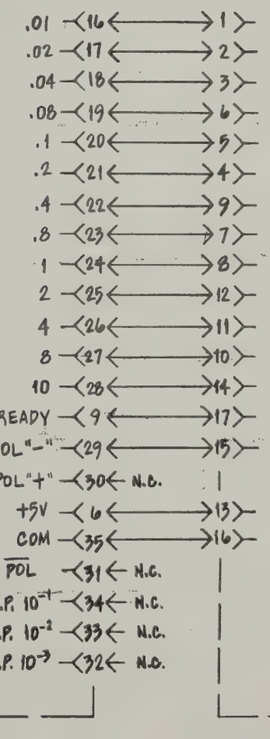
DESCRIPTION		NEXT ASSY
D	1-21-77	PACIFIC MEASUREMENTS INCORPORATED, PALO ALTO, CALIFORNIA
F	8-1-77	ISOLATED BCD INTERFACE
		DRAWING NO. 13848 REV B
		SHEET 1 OF 1

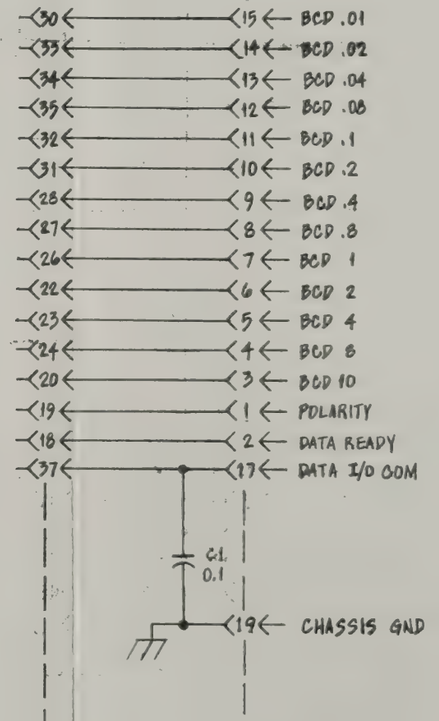
SYM	REVISION	ECO	DATE











A7
ASSEMBLY 13342
3 DIGIT DISPLAY LOGIC

A15
ASSEMBLY 13501
BCD INTERFACE

ITEM	REQD	PART NO.	DESCRIPTION
			LIST OF MATERIAL

NEXT ASSY

FINISH OR TREATMENT

UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE
.XX ± .015
.XXX ± .005

SCALE

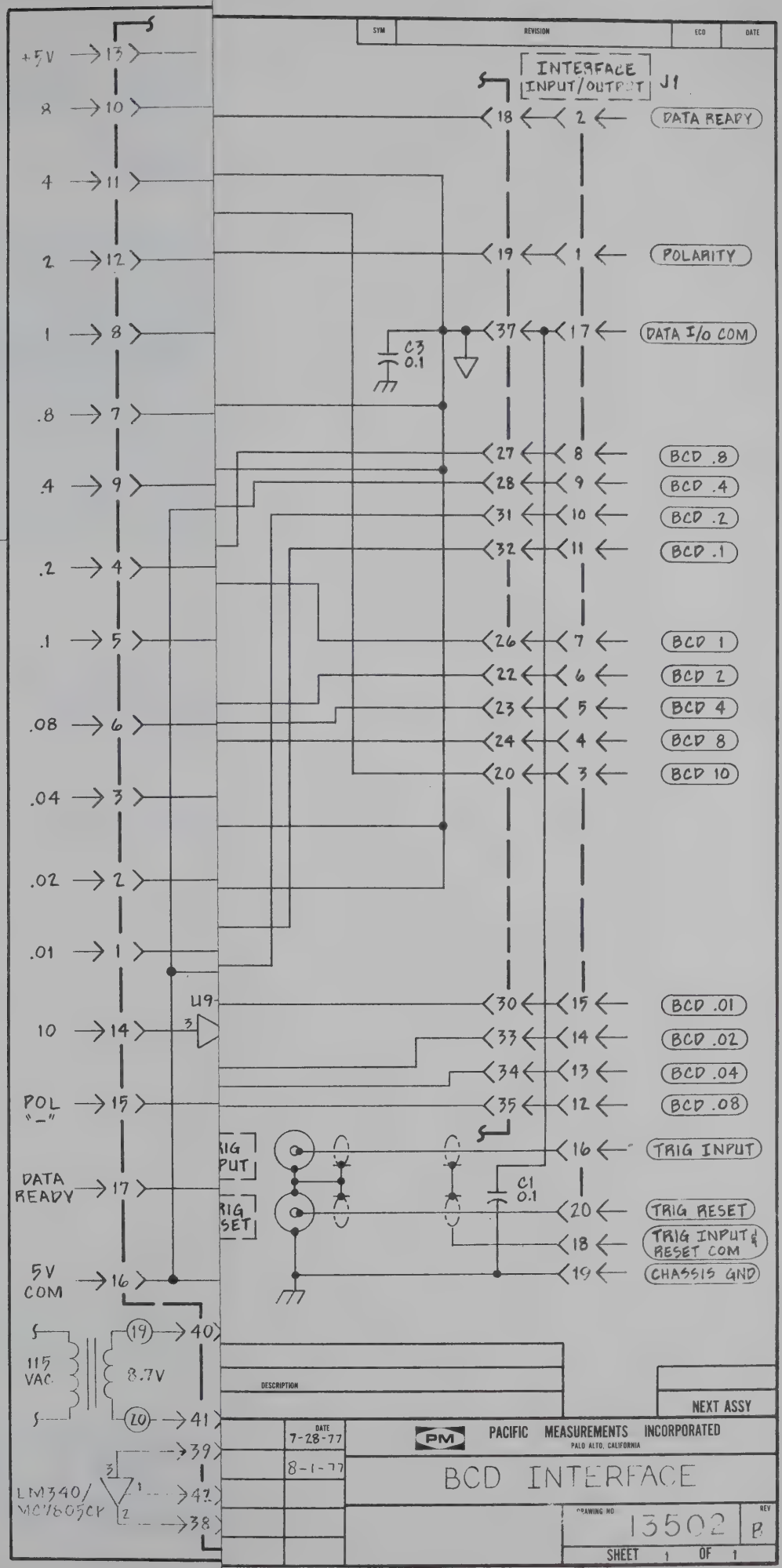
DRAWN	YO	1-21-77
ENG	ET	8-1-77
PROD		

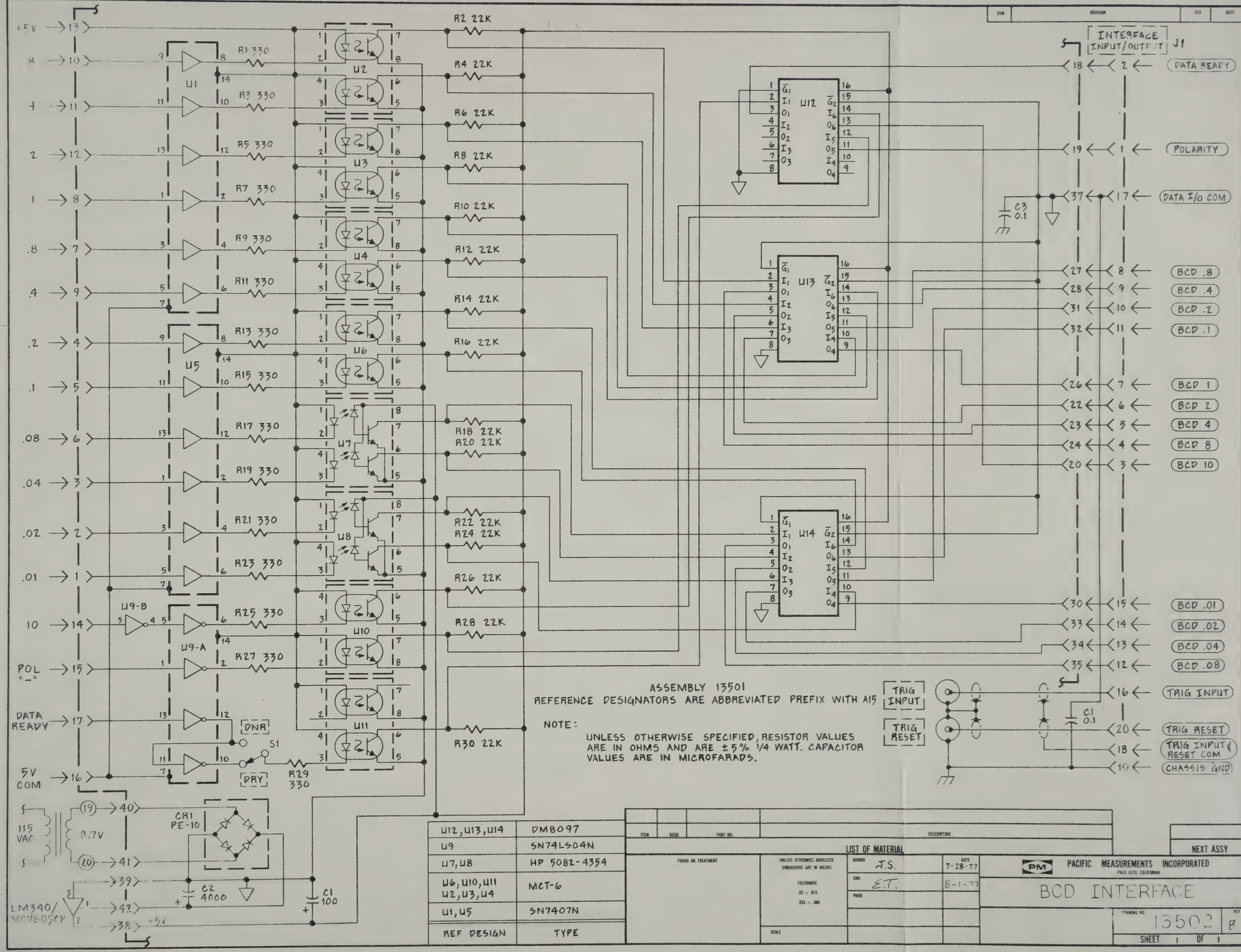
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA

ISOLATED BCD INTERFACE

DRAWING NO. 13848 REV B

SHEET 1 OF 1


SYM
REVISION
ECO
DATE
INTERFACE INPUT/OUTPUT J1
+5V → 13
8 → 10
4 → 11
2 → 12
1 → 8
.8 → 7
.4 → 9
.2 → 4
.1 → 5
.08 → 6
.04 → 3
.02 → 2
.01 → 1
10 → 14
POL "-" → 15
DATA READY → 17
5V COM → 16
18 ← 2 ← DATA READY
19 ← 1 ← POLARITY
37 ← 17 ← DATA I/O COM
C3 0.1
27 ← 8 ← BCD .8
28 ← 9 ← BCD .4
31 ← 10 ← BCD .2
32 ← 11 ← BCD .1
26 ← 7 ← BCD 1
22 ← 6 ← BCD 2
23 ← 5 ← BCD 4
24 ← 4 ← BCD 8
20 ← 3 ← BCD 10
U9
30 ← 15 ← BCD .01
33 ← 14 ← BCD .02
34 ← 13 ← BCD .04
35 ← 12 ← BCD .08
16 ← TRIG INPUT
C1 0.1
20 ← TRIG RESET
18 ← TRIG INPUT & RESET COM
19 ← CHASSIS GND
115 VAC
19 → 40
8.7V
20 → 41
39
LM340/ MC7805CK
42
38
DESCRIPTION
NEXT ASSY
DATE
7-28-77
8-1-77
PM
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA
BCD INTERFACE
DRAWING NO
13502
REV
B
SHEET 1 OF 1



ASSEMBLY 13501

REFERENCE DESIGNATORS ARE ABBREVIATED PREFIX WITH A15

NOTE:

UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS AND ARE ±5% 1/4 WATT. CAPACITOR VALUES ARE IN MICROFARADS.

REF DESIGN	TYPE
U12, U13, U14	DM8097
U9	SN74LS04N
U7, U8	HP 5082-4354
U6, U10, U11 U2, U3, U4	MCT-6
U1, U5	SN7407N

LIST OF MATERIAL

ITEM	REQD	PART NO.	DESCRIPTION

DRAWN	J.S.	7-28-77
ENG	E.T.	8-1-77
PROD		

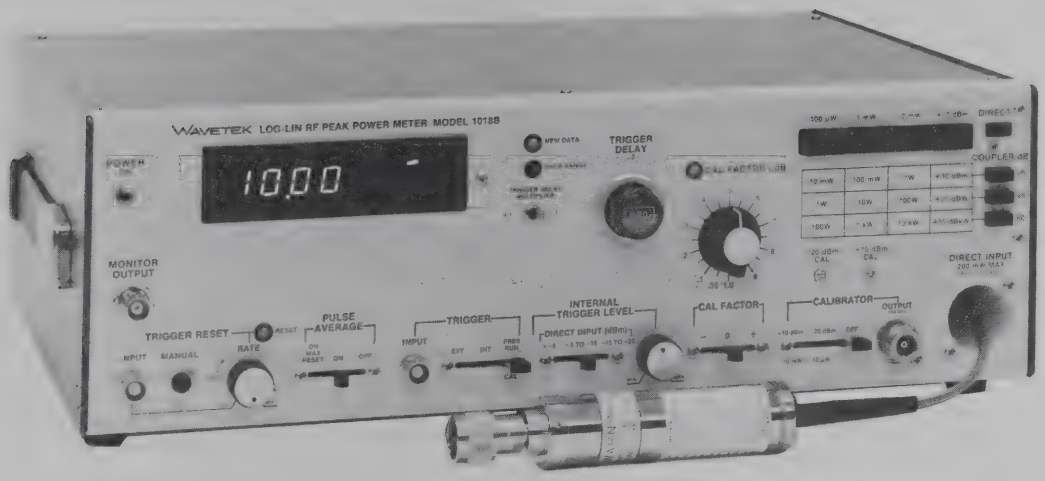
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA

BCD INTERFACE

DRAWING NO. 13502 REV B

SHEET 1 OF 1

OPERATING AND MAINTENANCE MANUAL



LOG/LIN RF PEAK POWER METER

MODEL 1018B

SERIAL NUMBER 817684

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TEL: (408) 734-5780 TWX: 910-339-9273

1499-14165 Code 25 (1-87)

WARRANTY

Wavetek warrants that all products manufactured by Wavetek conform to published Wavetek specifications and are free from defects in materials and workmanship for a period of one (1) year from the date of delivery when used under normal operating conditions and within the service conditions for which they were furnished.

The obligation of Wavetek arising from a Warranty claim shall be limited to repairing, or at its option, replacing without charge, any product which in Wavetek's sole opinion proves to be defective within the scope of the Warranty. In the event Wavetek is not able to modify, repair or replace non-conforming defective parts or components to a condition as warrantied within a reasonable time after receipt thereof, Buyers shall be credited for their value at the original purchase price.

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TABLE OF CONTENTS

Page No.

Section 1 GENERAL INFORMATION

1.1 Wavetek Microwave, Inc. Model 1018B Log/Lin RF Peak Power Meter 1-1
1.2 Model 1018B Performance Specifications 1-1

Section 2 INITIAL INSTRUCTIONS

2.1 Receiving Inspection 2-1
2.2 Power Requirements 2-1
2.3 Chassis Grounding 2-1
2.4 Returning The Instrument 2-1
2.5 Accessories 2-1

Section 3 OPERATION

3.1 Front Panel Controls 3-1
3.2 Front Panel Indicators 3-2
3.3 Front Panel Connectors 3-2
3.4 Rear Panel Connectors 3-2
3.5 Operating Procedure 3-3
3.5.1 Calibration 3-3
3.5.2 General Applications, CW and Repetitive Pulse Measurements 3-3
3.5.3 Single Pulse Measurement 3-4
3.5.4 Measurement of Selected Pulses Within a Train 3-4
3.5.5 Measuring Pulse Width 3-4
3.5.6 Measuring Pulse Risetime 3-4
3.5.7 Measurements Where RF Cables Are Required 3-5
3.5.8 Measuring Modulation 3-5

Section 3A SUPPLEMENTARY DATA FOR GPIB OPERATION (Instruments with Option 05 and/or 06)

A.1 Interface Bus for Output of Data and Input of Delay Setting and Trigger . A-1
A.2 Model 1018B, Option 05 Performance Specifications A-1
A.3 Modifications for Option 05 . . . . . A-2
A.4 Operation A-2
A.5 Description of Implementation of IEEE STD-488 for the Model 1018B A-3
A.6 Calibration of the Programmable Delay Board (A15) A-8
Schematic Diagrams
13364 Interface - Data Input
13367 Interface - Multiplexer
13841 IEEE Interface Bus
14092 Programmable Delay
Replaceable Parts Listings
Chassis Assembly #13573 . . . . . A-9
Interface-Data PC Board Assembly #13363 . . . . . A-10
Interface-Multiplexer PC Board Assembly #13366 . . . . . A-12
Auxiliary +5V Power Supply #13506 . . . . . A-14
Programmable Delay PC Board Assembly #14091 . . . . . A-15
Trigger Circuit PC Board Assembly #13522 . . . . . A-17
Supplementary Data Describing Option 06 (Trigger Delay) . . . . . Following A-17

Section 4 PERFORMANCE CHECKS

4.1 Purpose 4-1
4.2 Equipment Required 4-1
4.3 Calibrator 4-1
4.4 Power Level Tracking at 100MHz 4-1
4.5 Cal Factor Correction Accuracy 4-2
4.6 Input Circuit Rise Time 4-2

TABLE OF CONTENTS (con't.)

Page No.

Section 4 PERFORMANCE CHECKS (con't.)

4.7 Calibration of the Delay Relay 4-3

Section 5 CIRCUIT DESCRIPTION

5.1 General 5-1
5.2 Block Descriptions
5.2.1 Input Amplifier 5-2
5.2.2 Trigger Circuit 5-2
5.2.3 Sample-And-Hold Circuit 5-2
5.2.4 Compensation Amplifier 5-2
5.2.5 Log/Lin Amplifier 5-3
5.2.6 Calibrator 5-4
5.2.7 Digital Display 5-5

Section 6 MAINTENANCE

6.1 Periodic Maintenance 6-1
6.2 Internal Adjustments and Test Points 6-1
6.2.1 Description of Adjustments 6-1
6.2.2 Description of Test Points 6-2
6.3 *Calibration*
6.3.1 Equipment Required for Calibration 6-3
6.3.2 Calibration Procedure 6-3
6.4 Detector Maintenance 6-7
6.4.1 Detector Element Handling Precautions 6-7
6.4.2 Replacing the Detector Element 6-7
6.5 Troubleshooting 6-7
6.5.1 Localization of Trouble 6-8
6.5.2 Localization of Trouble to Individual Components 6-9
6.6 Parts Replacement
6.6.1 Replacement of Parts on Printed Circuit Boards 6-9
6.6.2 Replacement of Parts on the Front Panel 6-9
6.6.3 Removing Plug-In Printed Circuit Boards 6-9
6.6.4 Removal of the Calibrator 6-9
6.6.5 Semiconductor Devices 6-10
6.6.6 Detector Cable Storage 6-10
6.6.7 Access to the Range Switch PC Board (A2) 6-10
6.7 Wiring List 6-11
6.8 Active Device Voltages, Waveforms, Timing Diagrams, Functional Diagrams. 6-16

Section 7 PARTS LIST AND SCHEMATIC DIAGRAMS

Table of Contents 7-1

Section 8 MANUAL CORRECTIONS

LIST OF ILLUSTRATIONS (FIGURES AND TABLES)

Figures

Figure 1-1 Type N Connector Configuration 1-4
Figure 2-1 Voltage Selection 2-1
Figure 3-1A & B Model 1018B Front and Rear Panels . . . . . 2-2 & 2-3
Figure 3-2 Modulated Measurement Setup 3-6
Figure 3-3 Modulated Pulsed RF Signal 3-6

LIST OF ILLUSTRATIONS (FIGURES AND TABLES) (con't.)

Figures (con't.)

Figure A-1	Switch Array to Select GPIB Listen Address	A-2
Figure A-2	Switch Array to Select GPIB Talk Address	A-2
Figure A-3	Interface-Data Input PC Board Component Locations	with SD 13364
Figure A-4	Interface-Multiplexer PC Board Component Locations	with SD 13367
Figure A-6	Programmable Delay PC Board Component Locations	with SD 14092
Figure 5-1	Model 1018B Simplified Block Diagram	5-1
Figure 5-2	Detector Diagram	5-3
Figure 5-3	Log/Lin Amplifier Diagram	5-4
Figure 5-4	Oven Controller Diagram	5-4
Figure 6-1	Detector Components	6-7
Figure 6-2	Location of Front Panel Mounting Screws	6-10
Figure 6-3	Location of Calibrator Mounting Screws	6-10
Figures 6-4 through 6-22	Model 1018B Waveform Indications	pages 6-17 through 6-20
Figure 6-23	Trigger Circuit Functional Diagram	6-21
Figure 6-24	Trigger Circuit Timing Diagram	6-22
Figure 6-25	Oscillator Circuit Waveforms	6-24
Figure 6-26	State-Decoder Circuit Timing Diagram	6-25
Figure 6-27	Comparator Circuit Input Voltage and Output Timing Diagram	6-26
Figure 7-1	Model 1018B Power Meter PC Board and Assembly Locations	7-2
Figure 7-2	Front Panel Assembly Component Locations	7-4
Figure 7-3	+12.6V Power Supply PC Board Component Locations	7-8
Figure 7-4	Range Switch PC Board Component Locations	7-11
Figure 7-5	Input Circuit PC Board Component Locations	7-19
Figure 7-6	Rectifier Circuit PC Board Component Locations	7-22
Figure 7-7	Trigger Circuit PC Board Component Locations	7-27
Figure 7-8	Digital Display Circuit PC Board Component Locations	7-32
Figure 7-9	Calibrator Oscillator Circuit PC Board Component Locations	7-35
Figure 7-10	Calibrator Oscillator Board Assembly Component Locations	7-36
Figure 7-11	Power Detector Amplifier and Assembly Locations and Part Numbers	7-38
Figure 7-12	Pulse Amplifier PC Board Component Locations	7-39
Figure 7-13	Calibrator Factor Switch Component Locations	7-43
Figure 7-14	Display Readout PC Board Component Locations	7-46

Tables

Table 1-1	Model 1018B Performance Specifications	1-1
Table A-1	Model 1018B, Option 05 Performance Specifications	A-1
Table A-2	Data Byte Format	A-4
Table A-3	Typical Trigger Sequence	A-5
Table A-4	Typical Serial Poll Sequence	A-5
Table A-5	Trigger Delay Control Sequence	A-6
Table A-6	Sequence to Return Delay Control to Front Panel	A-7
Table 4-1	Power Level Tracking Values	4-2
Table 4-2	Cal Factor Values	4-3
Table 6-1	Attenuator Correction Factors	6-6
Table 6-2	Display Readings With Attenuation Between Calibrator and Detector	6-6
Table 6-3	Troubleshooting Indications and Checks	6-8
Table 6-4	Model 1018B Wiring List	6-11
Table 6-5	Control States for the Digital Display	6-23

SECTION 1

GENERAL INFORMATION

1.1 WAVETEK MICROWAVE'S MODEL 1018B LOG/LIN RF PEAK POWER METER

The Model 1018B measures RF pulses with widths as short as 0.25 µs. The instrument measures signals of amplitude between 10 µW (-20 dBm) and 10 mW (+10 dBm). The unit employs a 50Ω matched coaxial RF detector to make the measurement, and its frequency range extends from 100 MHz to 12.4 GHz. The instrument responds to each pulse individually; thus it is not sensitive to pulse width, repetition rate, duty factor or pulse shape. The pulse is detected, sampled, held and the data stored digitally each time the unit is triggered. The data is displayed on a 3-digit (plus overrange) digital display.

The instrument operates by sampling the detected video pulse from the detector. The sampling gate will automatically close upon the arrival of an RF pulse when on internal trigger. The point of sampling may be delayed up to 100µs from the leading edge of the pulse using the trigger delay control. Similarly, if external triggering is used the sampling point may be delayed up to 100 µs from the arrival of the external trigger. Thus, it is possible to adjust the delay so that the peak of each pulse is sampled. Alternatively, a plot of pulse amplitude vs. time may be obtained by taking data at points of successively greater delay. A monitor output supplies the signal corresponding to the detected RF power as amplified by the trigger level amplifier. This signal is useful for displaying the pulse on an oscilloscope and gives the operator an indication of the approximate pulse shape. At high trigger reset rates a video pip is added to the waveform at the monitor output so that the point of measurement may be observed on an oscilloscope. Built-in self calibration is provided.

1.2 MODEL 1018B PERFORMANCE SPECIFICATIONS

The specifications of the Model 1018B are given in Table 1-1.

TABLE 1-1

RF PERFORMANCE	
Operating Frequency Range:	100 MHz to 18.0 GHz (26.5 GHz with Option 07)
RF Power Measurement Range:	Direct, 10 microwatts to 10 milliwatts minimum; with external 20, 40 and 60 dB couplers (not supplied), 10 milliwatts to 10 kilowatts minimum.
RF Power Rating:	200 milliwatts maximum (direct) Peak or CW
RF Input Impedance:	Resistive, 50 ohms nominal.
RF Input VSWR (Return Loss):	100 MHz to 2 GHz, (1.1) 25 dB minimum; 2 GHz to 12.4 GHz, (1.2) 20 dB minimum; 12.4 GHz to 18.0 GHz, (1.4) 16 dB minimum.
RF Pulse Width Measurement Range:	0.375 microseconds to CW on internal trigger. 0.20 microseconds to CW on external trigger.
RF Pulse Shape:	The unit will measure the peak pulse power in rectangular and Gaussian shaped pulses at selected points within the pulses with equal accuracy.
RF Coded Pulse Measurement:	The unit will measure the peak pulse power of selected pulses within a position-coded pulse train whose duration is less 100 microseconds.

(continued)

TABLE 1-1 SPECIFICATIONS (Contd)

RF Power Measurement Characteristics:	
Frequency Correction Data:	Uncertainty of calibration at 1mW (0 dBm) is 2% (.09dB) to 12 GHz and 3.5% (.15dB) to 18 GHz.
Accumulated Error (linear mode)	± (3% of reading +1 count) + uncertainty of Frequency Correction Data over entire operating frequency range + calibrator uncertainty.
Accumulated Error (logarithmic mode)	± 0.3 dB + uncertainty of Frequency Correction Data over entire operating frequency range + calibrator uncertainty.
DISPLAY	
Readout Type:	In-line digital, $3\frac{1}{2}$ digits, uncertainty ± 1 count maximum.
Full Scale Ranges:	
Linear Mode	Direct, 100 microwatts, 1 milliwatt and 10 milliwatts. With directional couplers (not supplied): 20 dB, 10 milliwatts, 100 milliwatts and 1 watt; 40 dB, 1 watt, 10 watts, 100 watts; 60 dB, 100 watts, 1 kilowatt and 10 kilowatts. The scale markings and unit anunciator correspond to the power measurement ranges.
Logarithmic Mode	30 dB range with direct reading in dBm, dBW and dB KW.
Overrange:	10 percent between ranges (i.e., between 100 µW and 1 mW and 1mW and 10 mW) in linear mode, and to +10.5 dBm in the logarithmic mode. An overrange light indicates when in an overrange condition.
Display Rate:	Internally controlled, continuously adjustable for a non-blinking display; internally and externally synchronized, 0 to 500 readings per second minimum. Display resets to zero approximately 5 seconds after input signal has been removed.
Residual Noise:	Less than 1 dB peak to peak at -20 dBm (10 µW) and less than 0.2 dB peak to peak above -15 dBm (31.6 µW). With pulse averaging less than 0.2 percent of full scale (Linear Mode).
CONTROLS AND OPERATION	
Internal Calibrator:	An internal, stabilized CW oscillator is provided for use in standardizing or verifying the RF power measurement calibration of the unit.
Output Connector	Precision stainless steel. Type N female conforming to Figure 1-1.
Output Level	Selectable by a front panel switch: off; 10 microwatts, ± 2.5% maximum; 10 milliwatts, ± 1.5% maximum.

TABLE 1-1 SPECIFICATIONS (Contd)

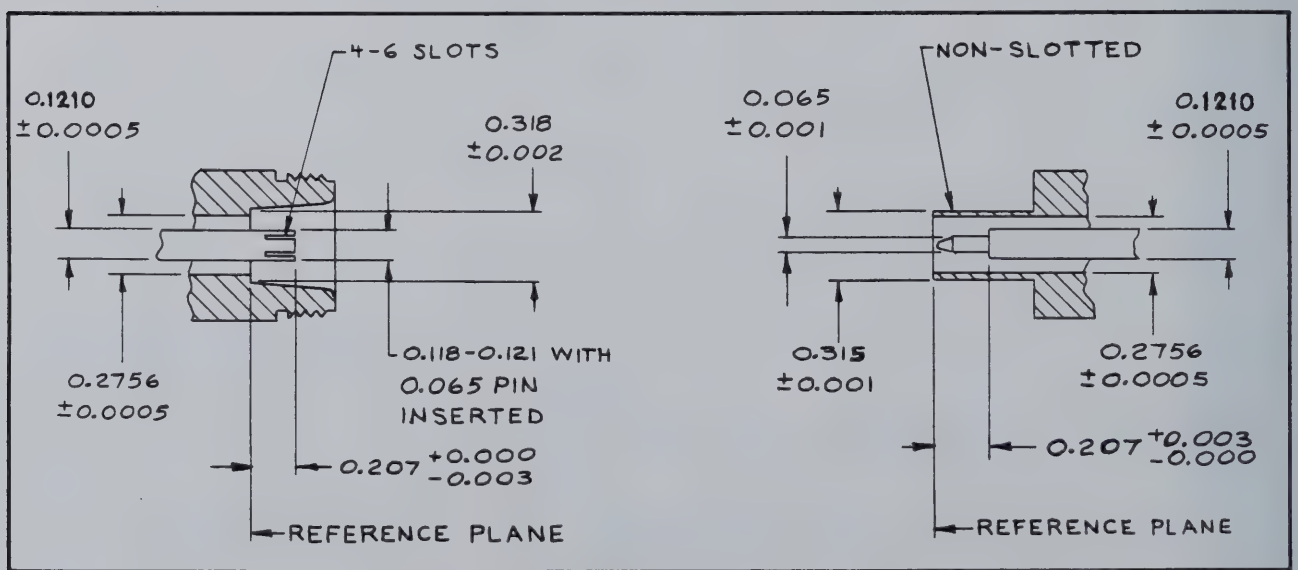
Residual Signals	All spurious, harmonic and nonharmonic signals are at least 50dB below the level of the fundamental signal at +10dBm output and at least 30dB at -20dBm output.
RF Output Impedance	Resistive, 50 ohms nominal.
RF Output VSWR	1.06 maximum (30 dB return loss) at calibrator frequency.
Calibrator Adjustment	A recessed rear panel screwdriver adjustment is provided to adjust the level of the internal calibrator. The resolution of the adjustment is better than 0.1% and has a range of at least 10%.
Calibrator Stability	The long-term (6 months) drift of the calibrator output is better than ± 1%.
Calibration Adjustment	Recessed screwdriver adjustments are provided on the front panel to set the digital display to indicate the internal calibrator output levels.
Frequency	105 MHz nominal.
Calibration Factor:	A front panel control is provided to correct the power meter reading, in both linear and logarithmic modes, for deviations of external directional couplers and attenuators from their nominal values. The control is marked in dB.
Correction Range	± 1.0 dB.
Increment	0.05 dB.
Trigger Selector:	A front panel control is provided to select either internal, external or free-run operation.
External Trigger Sensitivity	+ 1.5 volt minimum for pulses with widths greater than 0.2 microseconds or rise-times less than 1 microsecond. ± 10 volts maximum.
Internal Trigger Sensitivity	-25 to + 10 dBm in three ranges.
External Trigger Input Connector	BNC jack (Front & Rear Panel)
External Trigger Input Impedance	1 KΩ minimum.
Trigger Reset:	
Manual	A front panel pushbutton is provided for resetting the trigger.
Impedance	1 kΩ minimum.
Input Connector	BNC jack (Front & Rear Panel)

(Continued)

©

TABLE 1-1 SPECIFICATIONS (Contd)

Trigger Delay	A front panel, continuously variable control calibrated in microseconds is provided to delay the point in time where the pulse power is being measured; range, zero to 100 microseconds minimum; linerity, +2% of full range; maximum delay at zero setting, 0.35 microsecond.
Monitor:	A front panel connector is provided for monitoring the detected RF pulse envelope.
Level	Continuously adjustable by a front panel control; output, 0.5 volts peak-to-peak minimum with -20 dBm RF input.
Risetime	0.15 microseconds at input RF levels between 1 and 10 milliwatts.
Overshoot	5% maximum if terminated in 50Ω.
Marker	A marker is provided on the detected pulse waveform coincident with the peak pulse power measurement point.
Connector	BNC jack.
MISCELLANEOUS REQUIREMENTS	
Configuration:	The RF input head may be easily removed from the main unit for remote sensing of RF power at distances up to 4 feet from the main unit. The input head utilizes a male stainless-steel Type N connector, conforming to Figure 1-1, and is 5.12 inches in length, 1.17 inches in diameter and 8 ounces in weight.
Temperature Range:	Operating, 15°C to 45°C; nonoperating, -20°C to 71°C.
Size:	19" wide, 5 1/2 high, 13" deep.
Weight:	16 lbs. (7.2 Kg). Shipping 25 lbs. (11 Kg).
Supply Power:	100, 120, 220 & 240V +5% -10% between 48 and 480 Hz. 50 VA maximum.



TYPE N CONNECTOR CONFIGURATION
FIGURE 1-1

SECTION 2

INITIAL INSTRUCTIONS

2.1 RECEIVING INSPECTION

Inspect the instrument for shipping damage. See the receiving instruction under "Warranty" on page i at the beginning of the manual.

2.2 POWER REQUIREMENT

Before applying power to the instrument from the line, be sure that the instrument is set for the correct line voltage. The unit is connect at the factory for operation from 105 volts to 125 volts ac at 48 to 480 Hz. The combination of the module and transformer design allows instrument operation on 100, 120, 220, or 240 volts. Conversion from one voltage to another may be made by changing the voltage selection p.c. board. See Figure 2-1.

2.3 CHASSIS GROUNDING

The instrument is supplied with a three-conductor NEMA type power cord. The instrument will be properly grounded if the plug is connected into a properly installed three-prong receptacle. If a three-prong to two-prong adapter is used, be sure that the pigtail lead of the adapter is grounded.

WARNING

FAILURE TO PROPERLY GROUND THE INSTRUMENT CAN ALLOW DANGEROUS VOLTAGES TO BUILD UP ON THE CHASSIS WHICH COULD BECOME DANGEROUS TO OPERATING PERSONNEL.

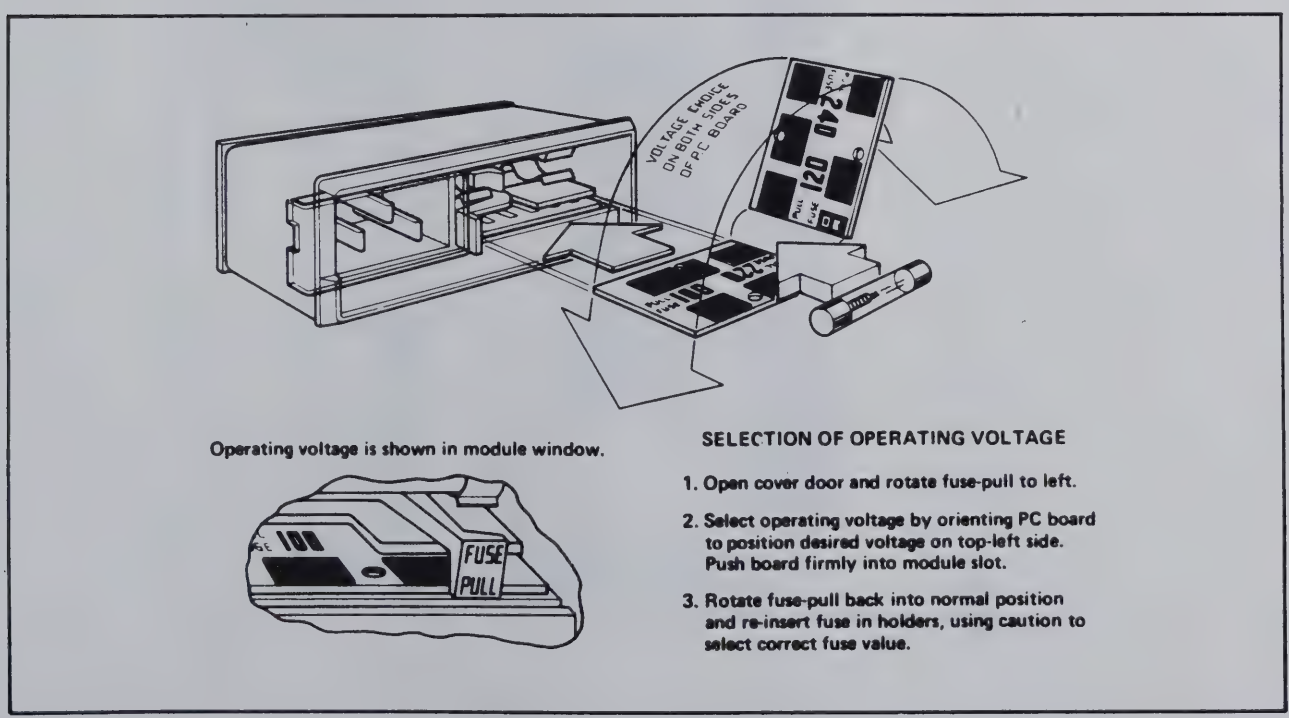
2.4 RETURNING THE INSTRUMENT

If it should be necessary to return the instrument to Wavetek Microwave, Inc., see the shipping instructions under "Warranty", page i at the beginning of the manual.

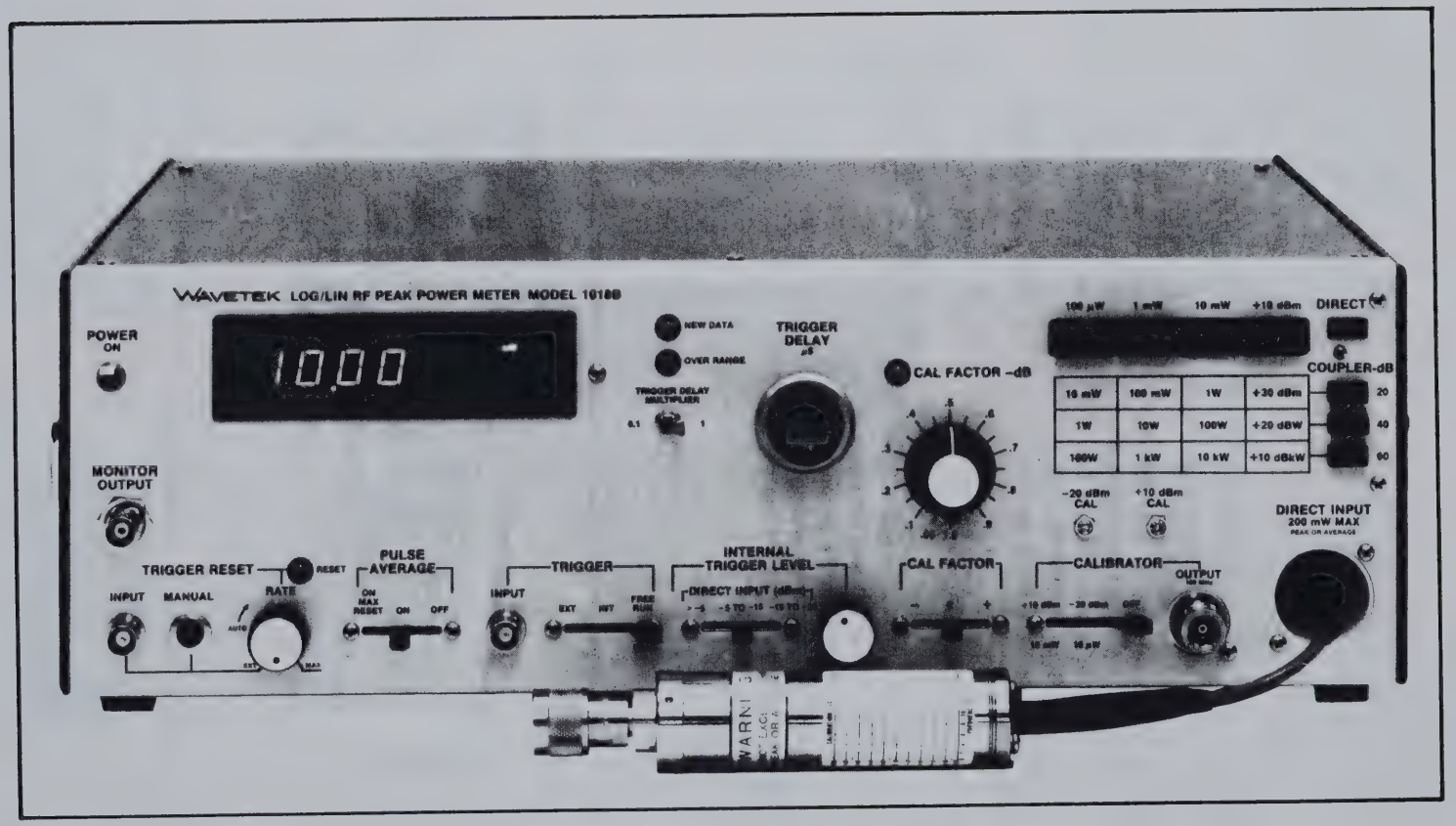
2.5 ACCESSORIES

The following are supplied with the instruments:

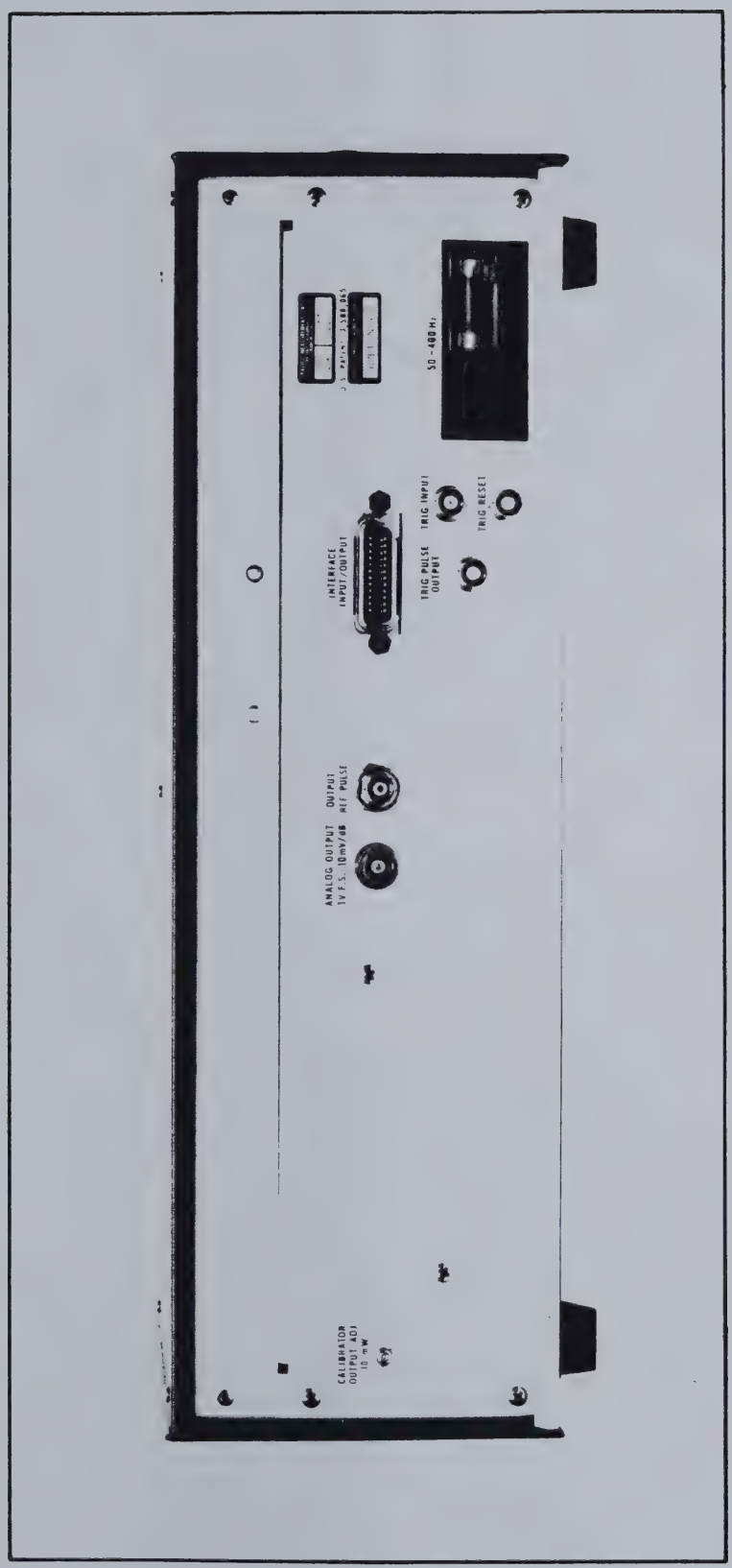
Qty.	Part Number	Description
1	12356	Power Cord
1	14165	Instruction Manual


VOLTAGE CHOICE ON BOTH SIDES OF PC BOARD
240
120
100
Operating voltage is shown in module window.
FUSE PULL
SELECTION OF OPERATING VOLTAGE
1. Open cover door and rotate fuse-pull to left.
2. Select operating voltage by orienting PC board to position desired voltage on top-left side. Push board firmly into module slot.
3. Rotate fuse-pull back into normal position and re-insert fuse in holders, using caution to select correct fuse value.

VOLTAGE SELECTION
FIGURE 2-1



FRONT PANEL
FIGURE 3-1A



REAR PANEL
FIGURE 3-1B

SECTION 3

OPERATION

3.1 FRONT PANEL CONTROLS

In addition to the power switch, the following controls are on the front panel of the instrument. See Fig. 3-1.

a. RANGE PUSHBUTTONS. The four mechanically interlocked pushbuttons arrayed in a horizontal line at the upper right corner of the panel control the operating range of the instrument. The three buttons to the left select linear operation; the labeling above the button corresponds to the full scale range of the display. The right-hand button selects a logarithmic display mode, with a full-scale range of +10 dBm (when the coupler selector is in the DIRECT mode).

b. COUPLER SELECTOR PUSHBUTTONS. The four mechanically interlocked buttons correct the display to compensate for the signal loss when using directional couplers to monitor power in a system. The unit can be compensated for couplers with 20, 40 or 60 dB loss. The coupler loss corresponding to each button is marked immediately to the right of the button. Full-scale readings are read from the matrix under the range buttons.

c. CAL FACTOR SWITCHES. The CAL FACTOR controls permit the instrument's reading to be corrected for a detector calibration factor differing from unity, or coupler losses differing from the nominal value by up to 1.00 dB. The lower three-position switch, marked - 0 +, selects whether the corrections will be subtracted from or added to the reading, or if none will be applied. In the + position corrections will be subtracted, in the - position they will be added. The top rotary switch selects the magnitude of the correction in .05 dB increments. It is inactive when the lower switch is set to 0. Set the lower switch to 0 when calibrating the instrument.

d. CALIBRATOR SWITCH. This three-position lever switch controls the RF level at the CALIBRATOR OUTPUT jack. Its three positions are OFF, -20 dBm (10 μW) and +10 dBm (10 mW).

e. +10 dBm CAL ADJUSTMENT. This screwdriver adjustment allows the instrument to be standardized to the 10 mW from the calibrator. The procedure for making this adjustment is described in Section 3.5.1c. The CAL FACTOR lever switch should be set to 0 and the CAL FACTOR light off.

f. -20 dBm CAL ADJUSTMENT. This screwdriver adjustment allows the instrument to be standardized to the 10 mW from the calibrator. The procedure for making this adjustment is described in Section 3.5.1c. The CAL FACTOR lever switch should be set to 0 and the CAL FACTOR light off.

g. TRIGGER SELECTOR SWITCH. This three-position switch selects the triggering mode for the unit. Triggering in the INTERNAL position is under the control of the INTERNAL TRIGGER LEVEL control described in h. below. In the EXTERNAL position a 1 V. positive pulse of 200 nS or more is required to trigger the unit. In the FREE RUN position no trigger is required and the instrument continuously samples the input RF. This position is used when measuring CW power or calibrating the instrument.

h. INTERNAL TRIGGER LEVEL CONTROLS. The DIRECT INPUT (dBm) switch allows the coarse setting of the internal trigger level and the knob permits fine adjustments between switch positions. These controls set the gain of the internal trigger amplifier and thus control the point at which triggering occurs. The labeling above the three positions of the switch provides a rough guide for setting it with respect to input power level. The controls permit a proper compromise between excess trigger sensitivity where the instrument is likely to trigger from spurious signals and noise, and insufficient sensitivity where it will not trigger at all. In general, the sensitivity should be set somewhat above the point where the unit begins to trigger. In addition, these controls set the amplitude of the signal at the MONITOR OUTPUT jack, as the same amplifier is used to supply the trigger circuits and the monitor output signal. If the controls are set so that the signal from the MONITOR OUTPUT is between 0.5 and 1 V triggering should occur reliably and the output waveform should conform well to the input waveform, within the risetime limitation specified.

i. TRIGGER DELAY. This ten-turn control is used to adjust the time delay between the point at which a trigger occurs and the point when a sample of the RF pulse is taken. This allows the instrument to be set to read the peak of the waveform or any other appropriate point. The delay is adjustable between 0 and 100 μS and is indicated by the digital indicator above the knob.

j. TRIGGER RESET CONTROLS. Before the instrument can take a reading the trigger circuit

must be reset. This is normally done automatically after a period of time sufficient for the operator to assimilate the data on the digital display. This time is set by the RATE control. As long as the dot on the RATE control is clockwise of the AUTO marking on the panel, the trigger will reset automatically after a period between 1 ms and 3 s, depending upon the position of the knob. When the dot is at EXT the trigger must be reset by an external pulse applied to the TRIGGER RESET INPUT jack or manually, by means of the MANUAL pushbutton. After the trigger has been reset, the instrument will trigger on the first trigger following. The RESET light indicates the reset condition, a feature of value when measuring single pulses. In general, the operation of these controls is similar to the single sweep controls found on oscilloscopes.

k. PULSE AVERAGING SWITCH. When measuring a train of pulses of equal amplitude it is desirable to display the moving average in order to reduce the effects of noise. The instrument will do this when this switch is set to ON MAX RESET. This position disables the RESET controls insuring that the maximum number of pulses will be averaged per unit time. If desired to average selected pulses, the control can be set to ON and the reset controls will function normally (this mode would only be used in conjunction with an external reset pulse). When set to OFF, no averaging takes place and the amplitude of each pulse sampled is displayed.

3.2 FRONT PANEL INDICATORS

a. DIGITAL DISPLAY. Display tubes indicate the power in the linear modes. In the Log mode, the signal level is displayed in dB relative to the reference indicated at the right-hand edge of the display. The sign indicator is active only in the Log mode. The measurement units are indicated directly to the right of the numerical display.

b. OVER RANGE LIGHT. When lit, this light indicates that the measuring capacity of the instrument has been exceeded and another range must be selected or the input power reduced. On the 10 mW or +10 dBm ranges the light will go on only when power in excess of 10 mW has been applied to the detector. Thus, an indication of over-range can serve as a warning to reduce the power to the detector to avoid exceeding the 200 mW maximum rating.

c. NEW DATA LIGHT. This light flashes each time new data is applied to the digital display. At high pulse repetition rates, the light will appear to glow continuously.

d. TRIGGER RESET LIGHT. This light indicates that the trigger circuit has been reset. See description under 3.1j above.

e. CAL FACTOR LIGHT. This light serves as a warning that the CAL FACTOR control is operative and that a correction has been applied to the reading.

3.3 FRONT PANEL CONNECTORS

a. INPUT TYPE N CONNECTOR. This connector, located on the power detector head is the RF input to the unit. The input impedance is 50Ω. Detailed specifications are listed in Table 1-1.

CAUTION

UNDER NO CIRCUMSTANCES SHOULD THE POWER INPUT TO THE DETECTOR EXCEED 200 mW, PEAK. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN DAMAGE TO OR BURN OUT OF THE SENSITIVE DETECTOR DIODE.

b. CALIBRATOR OUTPUT JACK. This type N jack supplies 105 MHz RF power for calibrating the instrument. Output impedance is 50Ω. Output level is determined by the calibrator switch described in Section 3.1d.

c. MONITOR OUTPUT. This BNC jack supplies a signal corresponding to the detected video output of the detector. It may be viewed using an oscilloscope having a rise time of 20 ns or less. The signal level is adjustable using the INTERNAL TRIGGER LEVEL control. See Section 3.1h and 3.5.2b. Impedance is nominally 50Ω.

d. TRIGGER INPUT BNC JACK. This connector accepts triggers synchronous with the input RF pulse. Triggers must exceed 1 V for at least 200ns. Impedance is 1000Ω. Connected parallel to rear panel.

e. TRIGGER RESET INPUT BNC JACK. This connector accepts pulses to reset the trigger circuit. Pulses must exceed 1 V for at least 200 ns. Impedance is 1000Ω. Connected parallel to rear panel.

3.4 REAR PANEL CONNECTORS

a. POWER JACK. This jack accepts a three-conductor power cord. The center pin is tied to the chassis of the instrument. See WARNING under Section 2.3.

b. REFERENCE PULSE OUTPUT. Each time a sample is taken of the input, an 80 ns pulse is supplied to provide an accurate time reference at the sampling instant. Impedance is nominally 50Ω.

c. ANALOG OUTPUT

The output coefficient is 1 volt full scale (10 mV/dB). When the input signal is removed, the analog output will not hold its previous reading indefinitely and will decay at a rate of less than 1mV/second.

The output is NEGATIVE when the instrument reads in the linear mode. Thus, a reading of 1.000 will correspond to -1.000 at the output. In the logarithmic mode, the output is inverted, accordingly a reading of +10dB corresponds to an output voltage of +0.100V.

To avoid ground currents, devices connected to the ANALOG OUTPUT connector should be isolated from ground.

d. TRIGGER INPUT BNC JACK

Connected parallel to front panel. See section 3.3 d.

e. TRIGGER RESET INPUT BNC JACK

Connected parallel to front panel. See section 3.3 e.

3.5 OPERATING PROCEDURE

CAUTION

CONTINUOUS OR PEAK POWER LEVELS IN EXCESS OF +23 dBm (200 mW) CAN DAMAGE THE CRYSTAL DIODE IN THE DETECTOR. ALWAYS TAKE PRECAUTIONS TO INSURE THAT THE DETECTOR INPUT WILL BE WELL BELOW THIS POWER LEVEL BEFORE CONNECTING IT TO A SOURCE OF RF POWER.

3.5.1 CALIBRATION

a. Connect the line cord. Be sure that it is properly grounded. Refer to Section 2.3 for grounding precautions.

b. Turn the POWER switch to ON. The digital display should light immediately.

c. Allow at least 10 minutes for warm-up and temperature stabilization (longer if the instrument has just been brought in from an extremely cold environment). Attach the detector to the CALIBRATOR OUTPUT jack and set the CALIBRATOR switch to -20 dBm. Set the CAL FACTOR lever switch to 0, the TRIGGER switch to FREE RUN, and the PULSE AVERAGING switch to ON MAX RESET. Depress the DIRECT button.

Depress the 100 µW button and adjust the -20 dBM CAL screwdriver adjustment so that the display reads 10.0 µW. Now depress the 10 mW button and move the CALIBRATOR switch to +10dBm. Adjust the +10 dBm screwdriver adjustment until the display reads 10.00 mW. If it has been necessary to make a large adjustment at either level, repeat the procedure as there is a slight interaction between the two adjustments.

3.5.2 GENERAL APPLICATIONS, CW AND REPETITIVE PULSE MEASUREMENTS

a. Connect the detector to the measurement point. BE SURE THAT NO MORE THAN 200 mW PEAK OR CW IS AVAILABLE AT THIS POINT. If it is desired to measure power in excess of the +10 dBm measuring capability of the Model 1018 B, connect suitable attenuators or directional couplers between the detector and the RF source. For example: to measure 1 kW, a 60 dB coupler would be appropriate.

b. Set the TRIGGER selector switch as required. If pulse power is measured, either INTERNAL or EXTERNAL triggering is required. For CW power set it to FREE RUN. If external triggering is used, supply a pulse with 1 V (positive) amplitude or greater and a minimum duration of 200 ns to the TRIGGER INPUT connector. If internal triggering is used, set the DIRECT INPUT (dBm) switch to the approximate level of the signal to be measured. Adjust the LEVEL knob for reliable triggering. The PULSE AVERAGING switch should be set to ON MAX RESET to minimize the effects of noise.

c. Adjust the TRIGGER DELAY to the desired point. The DELAY control, calibrated in µs, can be set to cause the instrument to take a sample at any desired point within its range. There is approximately 0.2 µs fixed delay between the arrival of a trigger and the sampling point when the TRIGGER DELAY control is set to 00.0. As an aid to adjusting this control, the sampling pulse is superimposed upon the RF pulse envelope from the MONITOR OUTPUT. Also, a reference pulse is available from a rear panel connector to indicate the sampling point. The trailing edge of the reference pulse is the sampling point. An oscilloscope with a rise-time of less than 20 ns is required to observe the monitor output, or the reference pulse. The INTERNAL TRIGGER LEVEL control should be readjusted so that the pulse from the MONITOR OUTPUT is between 0.5 and 1.0 V to avoid waveform distortion and provide reliable triggering. Final adjustment to the peak of the waveform can be done with reference to the digital display. If it is desired, other points besides the peak can be sampled. Using the DELAY dial and the digital display a plot of the

waveform can be constructed (within the rise-time limitations of the instrument).

3.5.3 SINGLE PULSE MEASUREMENT

a. Connect the detector to the measurement point. BE SURE THAT NO MORE THAN 200 mW PEAK OR CW IS AVAILABLE AT THIS POINT.

b. Set the controls as follows:

TRIGGER RESET RATE	- EXT
PULSE AVERAGING	- OFF
TRIGGER	- INT
INTERNAL TRIGGER LEVEL	- To the range within which the expected signal falls.
CAL FACTOR	- AS REQUIRED
RANGE	- dBm or the linear range which will not be driven over-range by the input signal.
TRIGGER DELAY	- As required; in general to a setting equal to one half the pulse width.

c. Press the MANUAL RESET TRIGGER before the pulse is expected; the TRIGGER RESET light should be lit. When the light goes out and the NEW DATA light flashes the pulse has arrived and the power measured will be displayed for a five second interval.

3.5.4 MEASUREMENT OF SELECTED PULSES WITHIN A TRAIN

a. Connect the detector to the measurement point. BE SURE THAT NO MORE THAN 200 mW PEAK OR CW IS AVAILABLE AT THIS POINT. Set the controls as in 3.5.3b except for the TRIGGER switch, which is set to EXT and the RESET RATE, which is set to MAX or as required. Apply an external trigger to the TRIGGER INPUT jack. The timing between the leading edge of the trigger pulse and the RF pulse must be known to within 10% of the pulse width. Set the delay to the time between the leading edge of the trigger pulse and the leading edge of the RF pulse plus one half of the RF pulse width.

b. If a train of pulses is less than 100 µS long and the repetition rate of the train is less than 500 Hz, another method can be used not requiring an external trigger source. Set the controls as in 3.5.3b, except for the RESET RATE, which is set to MAX or as required. Set the TRIGGER DELAY to the time between the leading edge of the first pulse and the leading edge of the pulse to be measured, plus one half the measured pulse width.

c. Where there is considerable jitter between the trigger pulse and the RF pulse, another method is possible. Set the controls as in 3.5.3b. Apply a trigger to the TRIGGER RESET INPUT just prior to the desired pulse but after the previous pulse. This resets the trigger circuit and it will trigger on the desired pulse. The TRIGGER DELAY is set to one half the pulse width.

3.5.5 MEASURING PULSE WIDTH

The Model 1018B may be used to measure the pulse width without the aid of an oscilloscope by using the following procedures:

a. Follow the operating procedure of Sections 3.5.2, 3.5.3, or 3.5.4.

b. Measure the peak power of the pulse using the dBm mode, note the reading. Next adjust the TRIGGER DELAY so that the sample point is on the leading edge of the pulse and the digital display reading 3.0 dB down. To do this you may have to use an external pretrigger. Note the reading on the TRIGGER DELAY in µs. Move the sample point to the trailing edge and 3 dB down. Note the TRIGGER DELAY reading and subtract the first reading from it. The difference is the pulse width at the 50% (-3 dB) points. Other points may be chosen if desired.

3.5.6 MEASURING PULSE RISETIME

The pulse rise or fall time may be measured using the following procedures if the rise-time exceeds 100 nS.

a. Follow the operating procedure of Section 3.5.2.

b. Measure the peak power using the appropriate linear scale, i.e., mW or µW. Then in turn adjust the TRIGGER DELAY until the digital readout reads 10% and 90% (power) of the peak value, while noting the TRIGGER DELAY setting at each position. The difference is the pulse risetime in µs. You may have to use an external pretrigger so that the TRIGGER DELAY control can move the sample point up and down the leading edge. The same measurement can be made on the trailing edge of the pulse.

3.5.7 MEASUREMENTS WHERE RF CABLES ARE REQUIRED

If an RF coaxial cable is used between the measurement point and the detector there will be an error due to the RF loss in the cable. This can be compensated out of the measurement by using the following procedure:

Obtain a CW signal source at the frequency of the desired measurement capable of between one and ten mW. Measure the source output using the procedure of Section 3.5.2, first connecting the detector directly to the source output. Note the reading. Now insert the cable between the source and the detector and adjust the CAL FACTOR switch until the same reading is displayed as was previously noted. Leave the CAL FACTOR switch in this position for subsequent measurements using the cable.

3.5.8 MEASURING MODULATION

The Degree of Modulation of microwave and RF signals modulated with repetitive audio or video waveforms can be determined by using the Model 1018B in the setup shown in Fig. 3-2. This procedure is especially useful when the microwave signal is pulsed and sine-wave modulated simultaneously.

3.5.8.1 MODULATED CW SIGNALS

a. Follow the operating procedure and precautions of Section 3.5.2.

b. Connect the delay generator on the delayed output from the oscilloscope to the EXT TRIGGER INPUT.

c. Adjust the delay so that you are measuring the maximum power level, using the linear ranges, at point P_A in Figure 3-3 (assume signal shown is CW).

d. Readjust the delay so that you measure the minimum power level at point P_B in Fig. 3-3.

e. If you can turn off the modulation, then measure level P_C which is the CW level without modulation then use Equation 1. If you cannot remove the modulation, use Equation 2.

f. The Degree of Modulation is then calculated from the formulae:

$$M = \frac{\sqrt{P_A} - \sqrt{P_B}}{2\sqrt{P_C}} \qquad \text{Equation 1.}$$

$$M = \frac{\sqrt{P_A} - \sqrt{P_B}}{\sqrt{P_A} + \sqrt{P_B}} \qquad \text{Equation 2}$$

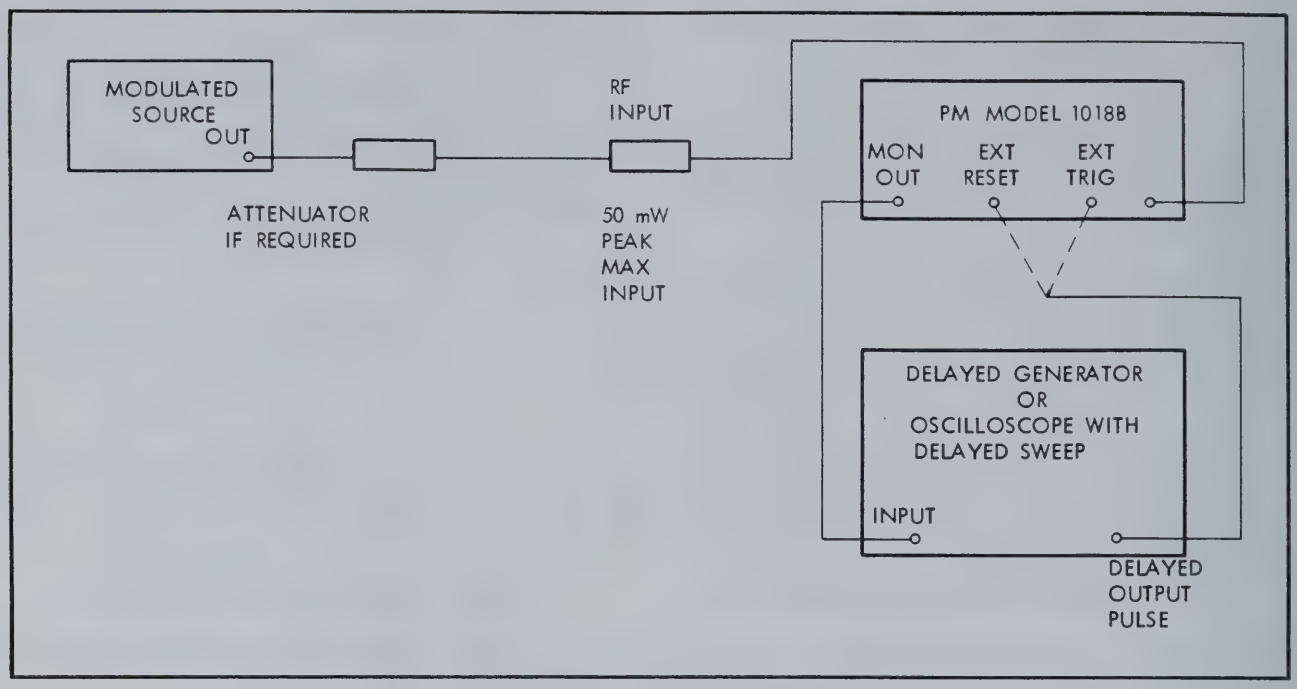
3.5.8.2 MODULATED PULSED SIGNALS

a. Follow the operating procedure and precautions of Section 3.5.2.

b. If there is very little jitter at the end of the delay and the measurement point is at the same point on the desired pulse each time, then the delayed pulse can be applied to the EXT TRIGGER INPUT. If it is not stable then apply it to the EXT RESET INPUT and operate the TRIGGER on INTERNAL.

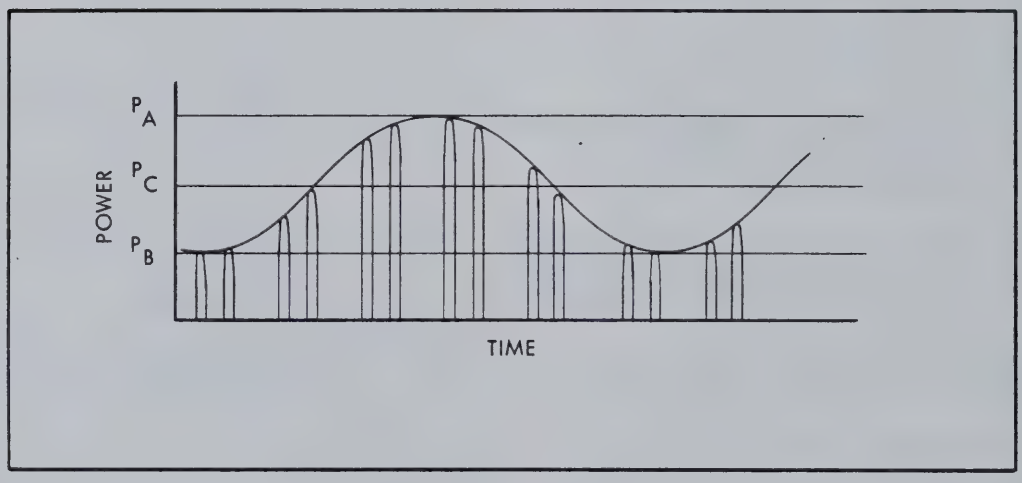
c. Adjust the delay so that you are measuring the maximum power level using the linear ranges. at point P_A in Figure 3-3. Note that you are resetting the trigger circuit just prior to the arrival of the desired pulse and since you are using internal triggering, pulse jitter, delay jitter or random pulse spacing does not affect the measurement.

d. Use Steps 3.5.8.1d,e, and f above to figure the Degree of Modulation.



MODULATED MEASUREMENT SET-UP

FIGURE 3-2



MODULATED PULSED RF SIGNAL

FIGURE 3-3

NOTICE

Information contained in this SUPPLEMENTARY DATA FOR GPIB OPERATION and TRIGGER DELAY section is intended only for Model 1018B Power Meters that have been equipped with Option 05 and/or Option 06. Option 05 allows the instrument to be remotely controlled through the IEEE STD-488 General Purpose Interface Bus (GPIB). Option 06 allows the selection of trigger delays of either 100 or 10μsec with proportional resolution. If the Model 1018B being used with this manual is not equipped with Option 05 and/or Option 06, please disregard this section.

The description of Option 06 will be found on the last page of this section.

Thank You

SECTION A

SUPPLEMENTARY DATA

A.1 INTERFACE BUS FOR OUTPUT OF DATA AND INPUT OF DELAY SETTING AND TRIGGER, ACCORDING TO IEEE STD 488-1975

This instrument is equipped with interface circuits to permit it to exchange information with other equipment using a data bus according to the specifications in the IEEE STD 488-1975 * (IEEE BUS).

There are two functions that can be programmed remotely from the bus. If so selected, the TRIGGER DELAY control can be disabled and the amount of trigger delay controlled from the bus. There is a trigger output on the rear panel which supplies a trigger at the time when the bus sends a "device trigger" command. A short length of cable with BNC connectors is used to connect this output to either the TRIGGER INPUT or the RESET TRIGGER INPUT. In this way, the instrument can be told to take a reading or made sensitive to trigger (when RESET TRIGGER is connected to the TRIGGER OUTPUT) so that it will take a reading when the next internal or external trigger is generated.

After the display has digitized the reading, it issues a "Service Request" on the bus. As soon as the controller responds and permits the Model 1018B access to the bus as a "talker", it will output the digits displayed and a code indicating the range it is set to. This process can be very rapid so that up to 500 readings can be transmitted per second.

A.2 Model 1018B, OPTION 05 PERFORMANCE SPECIFICATIONS

The instrument will meet the specifications called for in the IEEE Specification 488-1975. Details of the implementation of this are described in Section A.5., on page A-3. The code used is the American Standard Code for Information Interchange (ASCII).

* The Institute of Electrical and Electronics Engineers, Inc., IEEE Standard Digital Interface for Programmable Instrumentation (April 4, 1975).

TABLE A-1

PERFORMANCE SPECIFICATIONS

Programmed Functions:	Trigger (or Trigger Reset), Trigger Delay, Trigger Delay Range
Programming Message:	"GET" or "?" for Trigger. Four ASC11 bytes for delay control. See "Operation", Section A.4, page A-2, A-3.
Data Output:	Digital Display Data and Range.
Output Message:	"+" or "-" followed by four digits, followed by "," , followed by a digit "0" through "3" (range), followed by Carriage Return and Line Feed. See "Operation", Section A.4, page A-2.
Display Rate:	5 second retrigger has been removed.
INTERFACE TIMING	
Source handshake settling time allowed. (Time between placing multiline message on bus and DAV becoming true):	Approximately, 2.5 µs at least 2.0 µs guaranteed.
Acceptor handshake accept time. (Time between DAV becoming true and NDAC being sent false):	Approximately 10 µs.
Trigger Delay Accuracy:	100 µs range; 2% of full scale. 10 µs range; ± 1 µs.

A.3 MODIFICATION

The following assemblies have been added to the Model 1018B under this option:

PART NO.	DESCRIPTION
13572	Chassis Assembly
13363	IEEE Bus -Data Input PCB Assembly
13366	IEEE Bus - Multiplexer PCB Assembly
13506	Auxiliary Power Supply PCB Assembly
14091	Programmable Delay Trigger PCB Assembly

A switch has been added to the front panel to allow the front panel TRIGGER DELAY control range to be selected to be either the delay indicated (XI) or one-tenth of it (X0.1).

A.4 OPERATION

The instrument may be programmed and its data collected by a variety of controllers commercially available. The instrument accepts programming information after it has been addressed as a listener. Figure A-1, shows the switch array used to select a listen address for the instrument. To set a logical "1" for an address bit, the corresponding switch must be set to "open"; if closed, a "0" will be set. Similarly, the instrument transmits information after it has been addressed as a talker. Figure A-2, shows the talk address switch; it is set the same way as the listen address switch.

Under certain circumstances, it may be required to have the instrument permanently addressed as a talker; in this case, the "talk only" switch should be set open. This would be the case if the Model 1018B were just outputing data to a printer using the bus, for example. The "talk only " switch is located on the talk address switch array. In addition, it is optional whether the service request feature is to be used. If the service request feature is desired, SRQ Enable should be set. This switch is on the listen address switch array and is closed for SRQ Enable.

Access to these switches may be obtained by removing the five screws holding the top cover on the instrument and lifting the cover off. They are located on the board behind the digital display.

The programming of the delay setting is accomplished by sending the "remote enable" message, addressing the Model 1018B as a listener and sending the delay programming ASCII characters on the bus. The first character sets the range (either 0 to 9.99 µs or 0 to 99.9 µs); the remaining three characters program the digits. The first character should be "<" to program the 0 to 9.99 µs range or ">" to program the 0 to 99.9 µs range. Thus, the sequence ">316" will cause the delay to be set for 31.6 µs and the sequence "<254" will cause the delay to be set for 2.54 µs. For more detail, see Section A.5.

When the instrument has data ready, it will indicate this to the controller by setting SRQ (service request). The controller will normally conduct a serial poll to determine which instrument requires access to the bus as a talker. Alternatively, SRQ can be disabled and the controller can address the Model 1018B as a talker as part of a program step when data should be expected. In either case, after the instrument has been addressed as a talker, and it has data ready, it will output the data according to bus protocol. The first data character will be a "+" or "-" sign. The next four characters will be the displayed numbers. A comma, ",", will follow the numbers to separate them from the range data, which will be the number "0", "1", "2", or "3". A carrriage return "CR" followed by a line feed "LF" will then be sent to terminate the data string. The range numbers should be interpreted as follows:

RANGE	DATA FORMAT
0	SNNN.N dBm
1	SNNN.N µW
2	SNN.NN mW
3	SN.NNN mW

Thus, if the sequence, "-0147,0", is received, that

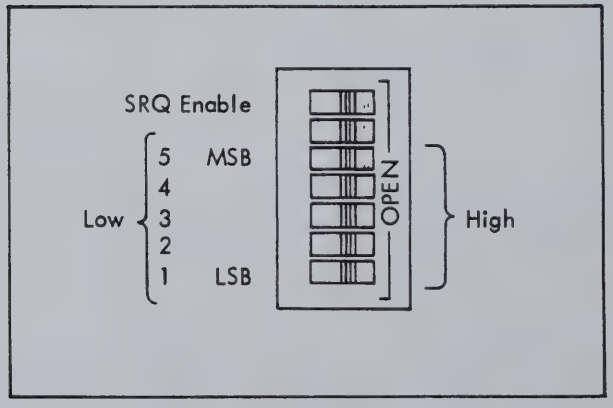


FIGURE A-1

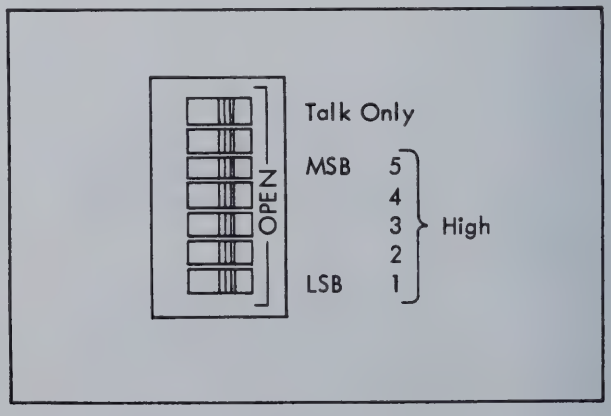


FIGURE A-2

would be interpreted to be "-14.7 dBm" with the leading zero ignored. Another example: "+1257,3" would be interpreted to be "1.257 mW", ignoring the sign, which is always plus for the linear ranges.

In order for the range data to have meaning, the Model 1018B should always be used in the DIRECT mode. Any correction of the reading for the use of attenuators or couplers should be done by the controller's program. Furthermore, you should use the dBm mode whenever possible as there is then no requirement to change ranges in order to maximize the resolution of the instrument. It is often easy to program the controller to convert the readings in dBm to linear equivalents if the data output is desired in that form, thereby providing linear data without requiring the operator to select the correct linear range.

When the Model 1018B is addressed as a listener and the interface message "GET" (group execute trigger) is sent, a pulse appears on the rear panel Trigger Output connector. If desired, this pulse can be used either to trigger the instrument to immediately take a reading or to "arm" it so that the next external or internal trigger will cause it to read. To trigger it directly, connect the Trigger Output pulse to the Trigger Input connector using a short BNC cable. If you want to merely arm the 1018B, connect the Trigger Output to the Reset Trigger Input. In most cases, the 1018B will be armed from the bus and triggered directly from the pulse waveform. This mode of operation guarantees that the proper delay will occur between the leading edge of the pulse and the sampling point, independent of the bus timing, yet still allows the system controller to select the pulse to be measured.

If it is not desired to control the trigger delay from the bus, local control can be maintained by several techniques: (1) Do not address the 1018B as a listener and give it programming words. (2) Address it as a listener and send the GTL (go to local) command. (3) Send REN (remote emable) false on the bus.

A.5 DESCRIPTION OF IMPLEMENTATION OF THE IEEE STD 488-1975 FOR PM MODEL 1018B

The interface bus is the implementation of a sub group of IEE Standard Digital Interface for Programmable Instrumentation (STD 488-1975).* The information is transmitted in byte serial, bit parallel form through the 8 bit, bidirectional data bus (D1 01-D1 08). The drivers are open collector TTL gates and the receivers are Schmitt TTL gates. The communication process is handled through the three lines of a hand shaking control bus (DAV, NDAC, NRFD). This permits asynchronous communication between the instrument and external devices. The five interface signal lines, (ATN, IFC, SRQ, REN, EOI) are used to manage an orderly flow of information between the devices. The logical "0" states corresponds to 2.4V (TTL high state) and logical "1" states corresponds to 0.8V (TTL low state).

The interface functions implemented in this instrument are as follows:

1. Source Handshake (SH) Function
2. Acceptor Handshake (AH) Function
3. Talker (T) Function
   a) Basic Talker
   b) Serial Poll
   c) Talk Only Mode
4. Listen (L) Function
   a) Basic Listener
5. Service Request (SR) Function
   a) Basic SR
   b) SRQ Disabled
6. Device Trigger (DT) Function
7. Interface Clear (IFC) Function
8. Attention (ATN) Signal
9. Programmable Trigger Delay (PTD)

SH FUNCTION

The SH interface function provides the instrument with the capability to guarantee the proper transfer multiline data. This function controls the initiation of, and termination of, the transfer of a multiline message byte, independent of ATN signal. When new data has been placed on the I/O bus. The data available signal (DAV) waits 2 µs before becoming true, and it becomes false again when the data accepted signal (NDAC) becomes true.

AH FUNCTION

The AH interface function provides the instrument with the capability to guarantee proper reception of remote multiline messages. This function may delay either the initiation of, or termination of, a multiline message transfer until it is prepared to continue with transfer process. In this instrument, the data accepted signal (NDAC) is sent 7 µs after DAV becomes true and ready for data signal (NRFD) is sent immediately after DAV becomes false.

TALKER FUNCTION

The T interface function provides the instrument with the capability to send data and status information over the interface to other devices. This can happen only when the T interface function is addressed to talk or when the "Talk Only" switch is opened. The instrument is addressed as talker when attention is true and the talk address (TAD) instruction contains the address matching the instrument's talker address in the last five least significant bits. The talker address can be specified on the instrument by setting the appropriate talker address selector switches (A12 S2). By pushing the proper switch to "open", that bit is set to "1". There can only be one device talking at any time. When the controller selects another device as the talker, the

* The Institute of Electrical and Electronics Engineers, Inc., IEEE Standard Digital Interface for Programmable Instrumentation (April 4, 1975).

present talking device loses its talking privilege. Also, the IFC signal will cause this instrument to be unaddressed as a talker. Suppose the talker address selector is set to 00110. Then as the controller sets ATN = 1 and sends the byte "X1000110" on the data bus, the instrument will start sending out data on the data bus whenever ATN is set to 0. The data bytes are in ASCII code, and they are formatted as illustrated in Table A-2.

The data stream is sent by the currently enabled talker to all currently enabled listeners. Bytes may be sent until the controller again set ATN to 1, otherwise the interface will send an interrupt message EOI = 1 and output ASCII "NULL" on data bus after the CR and LF. DAV will never become true again until the next "new data ready" initiates the sending of the next data block. The serial poll function will be discussed later under the Service Request section. When "talk only" switch is closed, the user has to make sure that no other devices are addressed as talkers, or else data would be sent from more than one device on the data bus whenever ATN becomes 0. The serial poll procedure will be discussed later on page A.5.

LISTENER FUNCTION

The L interface function provides the instrument with the capability to receive data over the interface from other devices. This can happen only when the L interface function is addressed to listen. There can be more than one device addressed as listener. The Unlisten (UNL) instruction will cause every device on the interface lines to be unaddressed as a listener. Also IFC signal will cause this instrument to be unaddressed as a listener.

Suppose the listen address selector is set to 00011. Then as the controller sets ATN = 1 and sends the byte X0100011 on the data bus, the instrument will respond by listening to the data bus.

There are three ways that the Listener Function can be utilized. The first two types of messages can be used to trigger the instrument. If it is desired to trigger the instrument as part of a group of instruments addressed as listeners, the Group Execute Trigger command (GET) should be used; see under "Device Trigger Function" below. The format of Table A-3 shows how to do this. Note that when a command is sent, Attention (ATN) is sent true. Alternatively, if only the Model 1018B is to be triggered, in addition to the GET command the instrument can be triggered by sending the data byte corresponding to the ASCII "?". With some types of controllers it is easier to send a data byte than a command. The third type of message that can

Controller Functions Talk/Listen	ATN	Opcode/Data	EOI	D08	D07	D06	D05	D04	D03	D02	D01	Comment
T	1	(TAD)5	0	X	1	0	0	0	1	0	1	The correct device select address in opcode enables the instrument to send data as soon as ATN becomes 0.
L	0	(XXXX)										
2 μs have passed since new data became available												
			0	0	0	1	0	1	0	1	1	+ Sign /
L	0	(DAB)1	0	0	0	1	0	1	1	0	1	- Sign
L	0	(DAB)2	0	0	0	1	1	0	0	0	D	D = 1 when display is over range (ie.> 9.99)
L	0	(DAB)3	0	0	0	1	1	D_4	D_3	D_2	D_1	10^2 digit data) D_4, D_3, D_2)
L	0	(DAB)4	0	0	0	1	1	D_4	D_3	D_2	D_1	10^1 digit data) D_1 corresponds) to BCD number
L	0	(DAB)5	0	0	0	1	1	D_4	D_3	D_2	D_1	10^0 digit data) of appropriate digit.
L	0	(DAB)6	0	0	0	1	0	1	1	0	0	Delimitor (,)
L	0	(DAB)7	0	0	0	1	1	0	0	D_2	D_1	Range: D_2 D_1 = 00 -- dB mode (xxx.x) D_2 D_1 = 01 -- linear mode (xxx.x) D_2 D_1 = 10 -- linear mode (xx.xx) D_2 D_1 = 11 -- linear mode (x.xxx)
L	0	(DAB)8	0	0	0	0	0	1	1	0	1	Carriage Return
L	0	(DAB)9	0	0	0	0	0	1	0	1	0	Line Feed
L	0	(DAB)10	1	0	0	0	0	0	0	0	0	End of data, DAV is set to false until new data signal indicates it is ready again.

TABLE A-2 DATA BYTE FORMAT

Controller Functions Talk/Listen	ATN	Opcode/Data	D08	D07	D06	D05	D04	D03	D02	D01	Comments
T	1	UNL	X	0	1	1	1	1	1	1	Inhibit all current listeners (Can be omitted if not required)
T	1	(LAD)3	X	0	1	0	0	0	1	1	Each select address in opcode sent from the controller enables a specified device to receive future data bytes. More than one address may be sent if multiple listeners are desired.
T	1	(LAD)n	X	0	1	A_5	A_4	A_3 (n)	A_2	A_1	
T	1	GET	X	0	0	0	1	0	0	0	Devices that are current listeners will generate a trigger pulse.
T	1	UNL	X	0	1	1	1	1	1	1	Unlisten

TABLE A-3 TYPICAL TRIGGER SEQUENCE

that can be sent is programming information to the programmable delay circuit. This is described below under "Programmable Trigger Delay (PTD) Functions" and Table A-5.

WARNING

THE PROGRAMMABLE DELAY CIRCUITS REQUIRE 100 µS TO SETTLE. BE SURE THAT YOUR PROGRAM ALLOWS AT LEAST THIS LONG BETWEEN PROGRAMMING THE DELAY AND SENDING A TRIGGER (EITHER GET OR "?").

SERVICE REQUEST FUNCTION

The SR interface function provides the instrument with the capability to asynchronously request service from the controller in charge of the interface. It sends out a SRQ message (interrupt) whenever the instrument is not addressed as a talker and new data is ready from the instrument. The controller then enables Serial

Controller Functions Talk/Listen	ATN	Opcode/Data	SRQ	D08	D07	D06	D05	D04	D03	D02	D01	Comments
T	1	UNL	1	X	0	1	1	1	1	1	1	Prevents other devices from listening to status byte later.
T	1	SPE	1	X	0	0	1	1	0	0	0	Put interface into serial poll mode during which all devices send status instead of data when enabled.
T	1	(TAD)n	1	X	1	0	A_5	A_4	A_3 (n)	A_2	A_1	Enables a specific device with address "n" to send status. Devices should be sequentially enabled.
L	0	(SBN)	1	X	0	0	0	0	0	0	0	Status byte sent by enabled device. If (SBN) was sent the controller should repeat the loop for next device address. If (SBA) was sent, the enabled device is identified as having sent RQS message over the interface and device will remove SRQ.
T	1	SPD	0	X	0	0	1	1	0	0	1	Remove the interface from serial poll mode.
T	1	(LAD)n	0	X	D	1	A_5	A_4	A_3 (n)	A_2	A_1	Address Listener to receive data.
L	0	(DAB)	0	X	0	0	0	1	X	X	1	Data bytes sent by currently enabled talker (the one that sent SRQ) to all currently enabled listeners.
L	0	----etc.	-	-	-	-	-	etc.	-	-	-	

TABLE A-4 TYPICAL SERIAL POLL SEQUENCE

Poll Mode and starts polling every device connected to it. The instrument will send the affirmative poll response bit (bit 7) of the status byte when it is polled, so that the SRQ message can be removed from the interface and the controller can service the device that was interrupting it. When it is desired that the controller not be interrupted by this instrument, the "SRQ enable" switch A12S1 can be opened so that no SRQ message can be sent by the instrument.

The format in Table A-4 illustrates the serial poll process.

DEVICE TRIGGER FUNCTION

The DT interface function provides the instrument with the capability to have its basic operation started either individually or as part of a group of devices. When the instrument is addressed as a listener, the GET message sent by the controller to the interface will provide a TTL positive pulse of 7 μs duration at the BNC connector at back panel; this signal can then then be used for the TRIGGER INPUT or RESET TRIGGER INPUT of the 1018B. Both trigger inputs are duplicated at the back panel, so depending on the system configuration of the user, either one of them can be connected by a short coaxial cable to the trigger output of the interface. Refer to the section on Listener Function for details of interface sequence.

INTERFACE CLEAR SIGNAL

IFC interface signal is used to place the interface system in a known quiescent state. In this instrument, the IFC signal or Power On generate CLR (clear) signal that is used to reset instrument as a non talker and non listener, reset the serial poll mode and SRQ message.

ATTENTION SIGNAL

ATN interface signal is used to specify how data bus D10 is to be interpreted. ATN = 0 means data bus is used to transfer data or status bytes. ATN = 1 means the data bus is used to transfer commands.

PROGRAMMABLE TRIGGER DELAY (PTD) FUNCTIONS

The PTD function provides the instrument with the capability to have its trigger delay set either by the IEEE interface bus, or the front panel control. This allows the instrument to sample the RF power pulse waveform at any particular point after a trigger occurs. There are 2 range selections available for the trigger delay; the x1 multiplier sets the delay between 0-99.9 μ sec. in 0.1 μ sec. and the x0.1 multiplier sets the delay between 0-9.99 μ sec. in 0.01 μ sec. step.

The selection of the remote or local trigger delay control is made through the use of the REN interface signal lines in conjunction with the listen function, described before. In the local mode, the delay is controlled by the ten turn digital knob at the front panel and by the range multiplier switch at the front panel.

Controller Functions Talk/Listen	ATN	Opcode/Data	REN	D08	D07	D06	D05	D04	D03	D02	D01	Comments
T	1	UNT	0	X	1	0	1	1	1	1	1	Disable the talker so it won't interfere with controller in setting the delay.
T	1	UNL	0	X	0	1	1	1	1	1	1	Disable all current listener
T	1	(LAD)2	1	X	0	1	0	0	0	1	0	Set the instrument to be a listener (assume the listener addr. switch was set to 2) & set remote control enable.
T	0	(DAB)1	1	X	0	1	1	R_4	R_2	R_2	R_1	Set range multiplier
T	0	(DAB)2	1	X	0	1	1	D_4	D_3	D_2	D_1	Set most significant digit
T	0	(DAB)3	1	X	0	1	1	D_4	D_3	D_2	D_1	Set middle digit
T	0	(DAB)4	1	X	0	1	1	D_4	D_1	D_2	D_1	Set least significant digit
T	1	UNL	1	X	0	1	1	1	1	1	1	Unlisten
T	1	(TAD)1	1	X	1	0	0	0	0	0	1	Set the instrument to be a talker (assume the talker addr. switch was set to 1)
L	0	(DAB)1	1	X	0	1	1	X	X	X	X	The data is read after the present trigger delay.

TABLE A-5 TRIGGER DELAY CONTROL SEQUENCE

On the other hand, the delay in the remote-controlled state is completely set by a sequence of 4 ASC11 bytes sent through the bus. The first byte controls the selection of multiplier, the 2nd, 3rd, and 4th bytes are the 3 digit-numbers of the delay control. The 2nd byte corresponds to the most significant digit and 4th byte corresponds to the least significant digit. The range select code for the x1 multiplier is the ASC11 symbol ">". The range select code for the x0.1 multiplier is the ASC11 symbol "<". Selecting the range sets the delay to Ø. REN must be sent true during the whole remote programming period.

In programming the delay, if extra bytes are transmitted, the last four set the delay. The format in Table A-5 illustrates how the trigger delay function is programmed. There are 2 ways of returning the instrument to the local mode of setting the trigger delay; if all the devices connecred to the bus are to return to the local control, simply reset REN = 0. If there are only certain devices that are to return to the local controls, only these devices should be enabled as the listeners before sending the GTL (go to local) control message. The format in Table A-6 illustrates this process.

Controller Functions Talk/Listen	ATN	Opcode/Data	REN	D08	D07	D06	D05	D04	D03	D02	D01	Comments
T	1	UNL	1	X	0	1	1	1	1	1	1	Disable all listeners
T	1	(LAD)2	1	X	0	1	0	0	0	1	0	Address the device that is to be returned to local control as a listener
T	1	GTL	1	X	0	0	0	0	0	0	1	Send the "go to local" message
T	1	UNL	1	X	0	1	1	1	1	1	1	Disable all listeners

TABLE A-6 SEQUENCE TO RETURN DELAY CONTROL TO FRONT PANEL

A.6 CALIBRATION OF PROGRAMMABLE DELAY BOARD (A15)

Equipment Required:

a. GPIB Controller

b. A frequency Counter/Time Interval Meter with counting capability to 125 MHz. The time interval function must have separate start and stop inputs and a minimum resolution of 100 nsec.

c. A Pulse Generator capable of supplying a 0.5 µs pulse with a repetition rate of 500 Hz. Amplitude capability to 2V into 50 ohms. Maximum rise-time of 10 nsec.

Procedure:

1. Connect the controller to the GPIB connector of the 1018B.
2. Apply a +1.5V pulse to the TRIGGER INPUT and set TRIGGER to EXT.
3. Connect the OUTPUT REF PULSE to the stop input of the Counter/Timer, and the trigger output of the pulse generator to the start input of the Counter/Timer.
4. Set the TRIGGER DELAY on the 1018B to 00.0 µs and record the reading on the Counter/Timer. It should be about 350 nsec.
5. Set the TRIGGER DELAY on the 1018B to 100.0 µs and record the reading on the Counter/Timer. It should be about 100.35 µs.
6. Send ">ØØØ" to the 1018B from the controller. This should put the 1018B on remote control and set the delay to minimum. Adjust OFFSET ADJ (A15R54) for the same counter reading as in Step 4.
7. Send ">:ØØ" to the 1018B from the controller. This sets the delay to full scale. Adjust F.S.ADJ (A15R33) for the same counter reading as in Step 5.

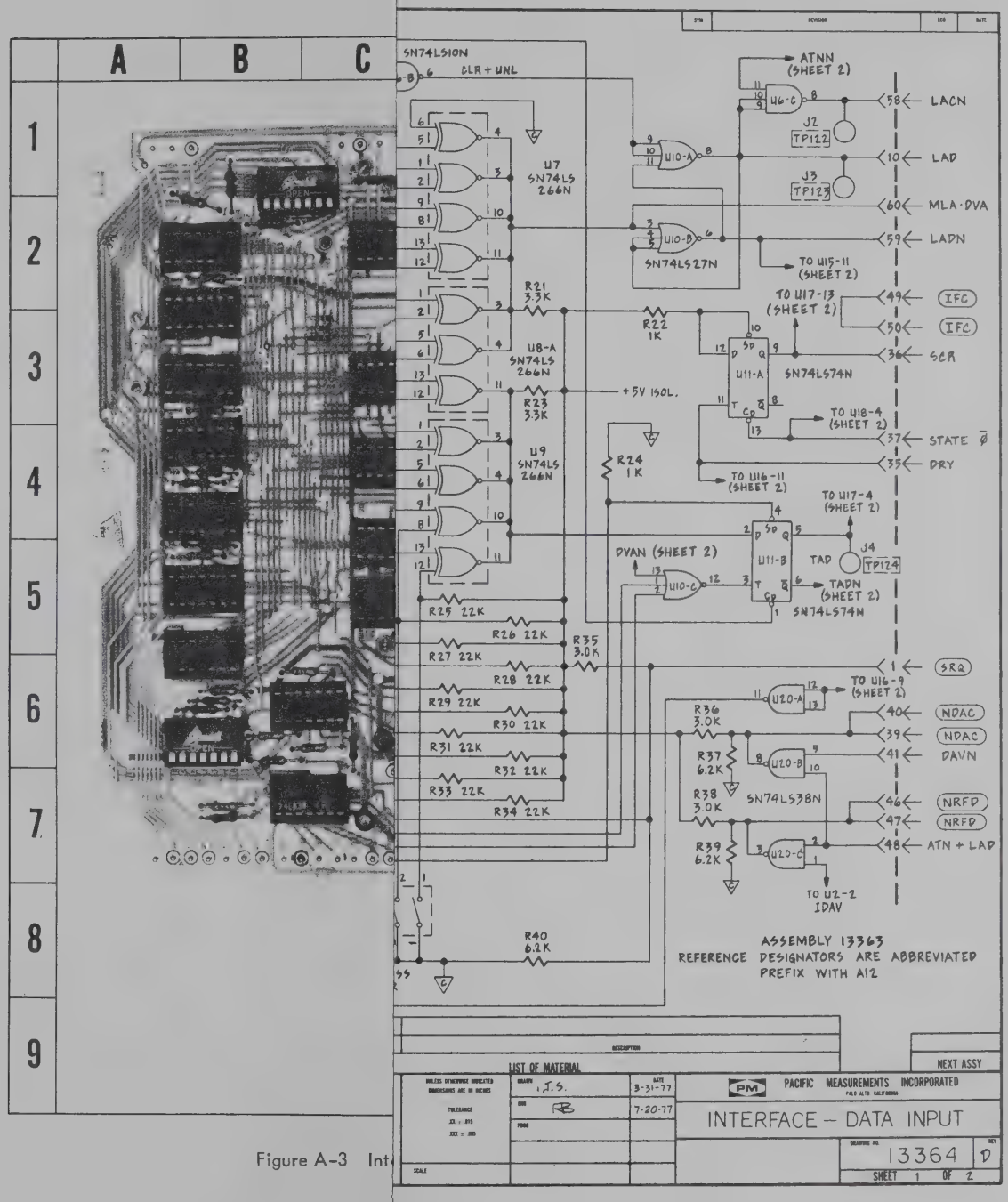


Figure A-3 Int

A.6 CALIBRATION OF PROGRAMMABLE DELAY BOARD (A15)

Equipment Required:

a. GPIB Controller

b. A frequency Counter/Time Interval Meter with counting capability to 125 MHz. The time interval function must have separate start and stop inputs and a minimum resolution of 100 nsec.

c. A Pulse Generator capable of supplying a 0.5 μs pulse with a repetition rate of 500 Hz. Amplitude capability to 2V into 50 ohms. Maximum rise-time of 10 nsec.

Procedure:

1. Connect the controller to the GPIB connector of the 1018B.
2. Apply a +1.5V pulse to the TRIGGER INPUT and set TRIGGER to EXT.
3. Connect the OUTPUT REF PULSE to the stop input of the Counter/Timer, and the trigger output of the pulse generator to the start input of the Counter/Timer.
4. Set the TRIGGER DELAY on the 1018B to 00.0 μs and record the reading on the Counter/Timer. It should be about 350 nsec.
5. Set the TRIGGER DELAY on the 1018B to 100.0 μs and record the reading on the Counter/Timer. It should be about 100.35 μs.
6. Send ">ØØØ" to the 1018B from the controller. This should put the 1018B on remote control and set the delay to minimum. Adjust OFFSET ADJ (A15R54) for the same counter reading as in Step 4.
7. Send ">:ØØ" to the 1018B from the controller. This sets the delay to full scale. Adjust F.S.ADJ (A15R33) for the same counter reading as in Step 5.

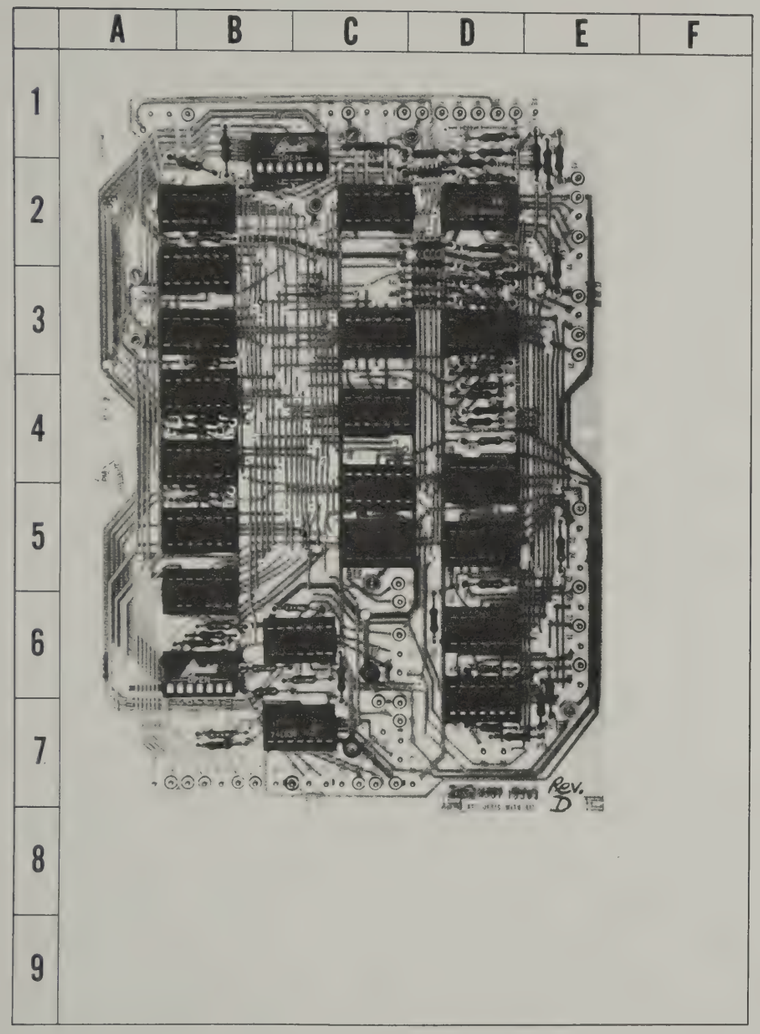
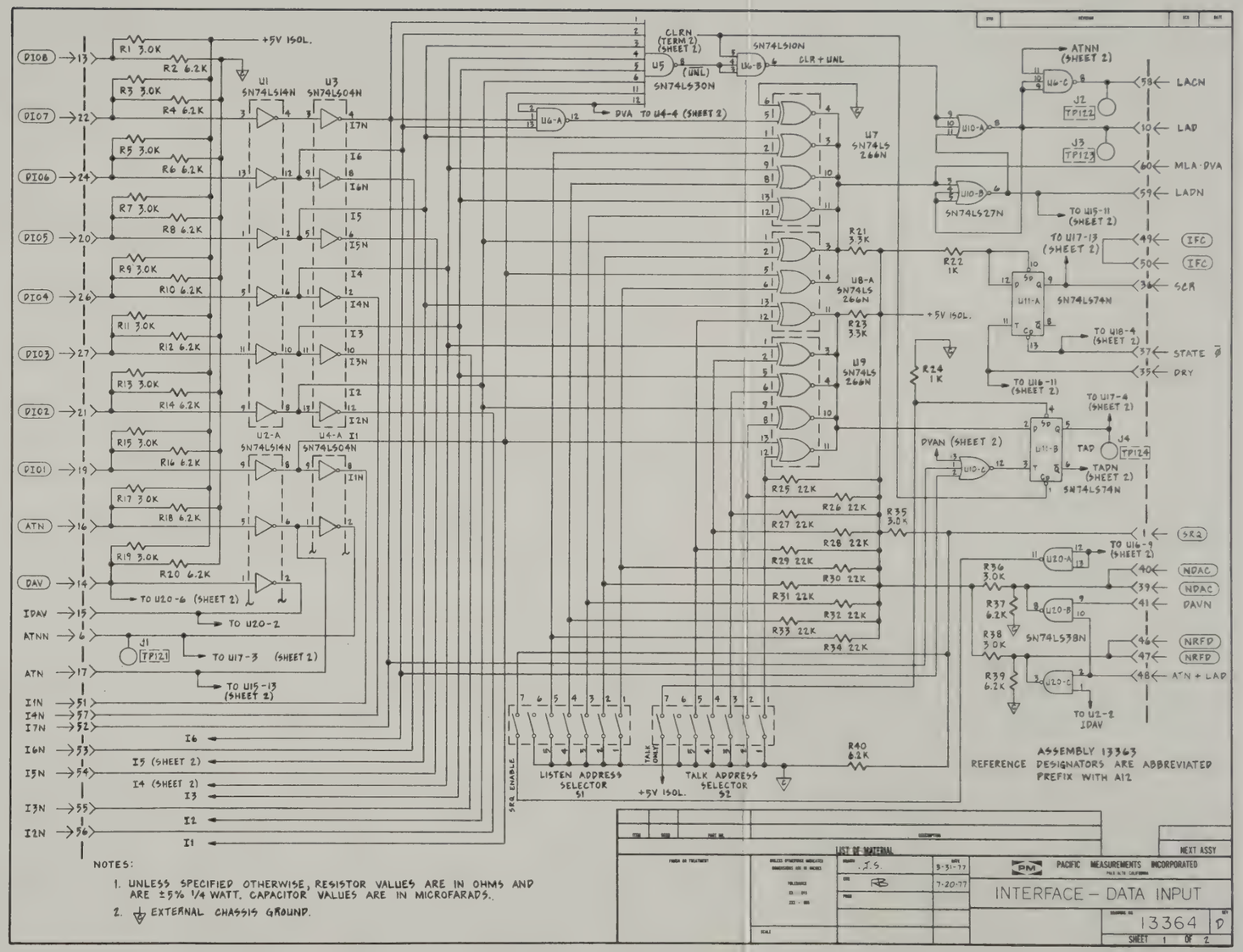
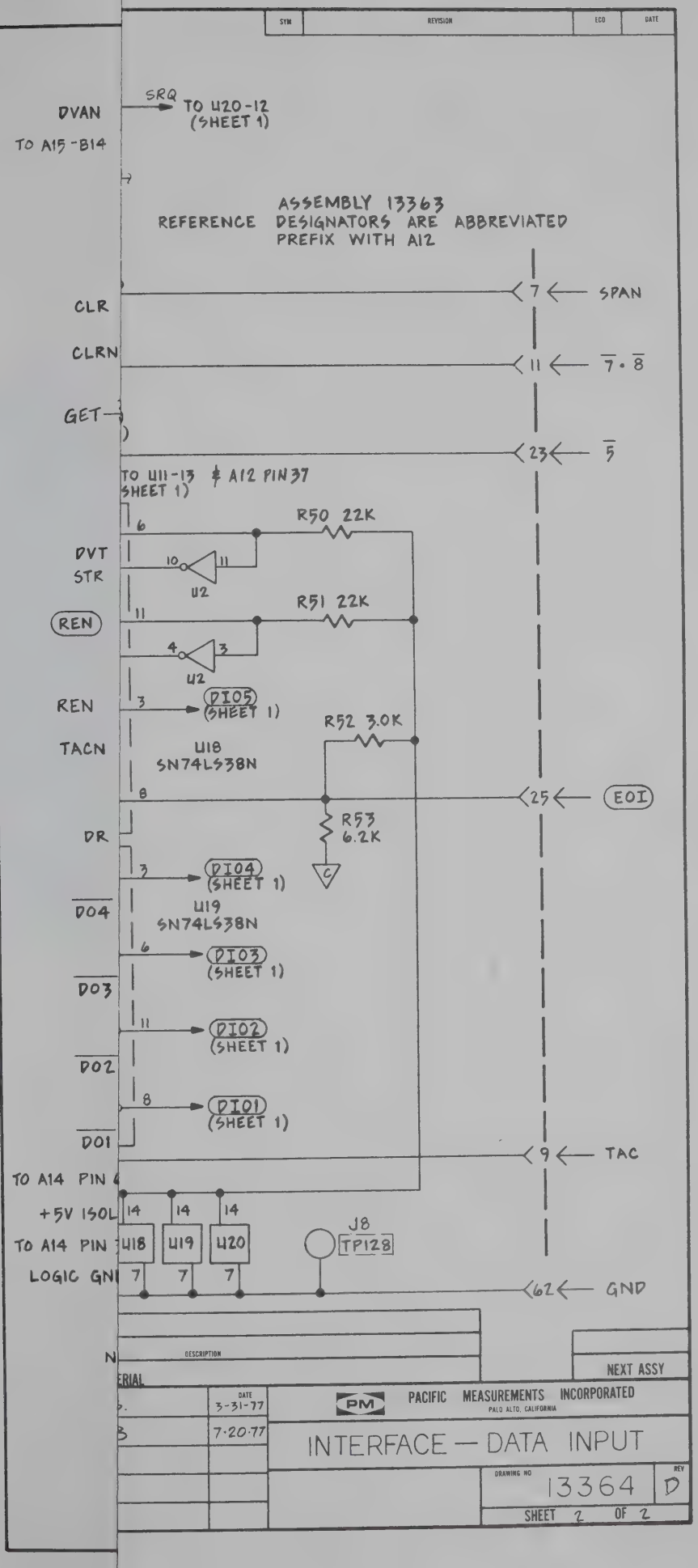
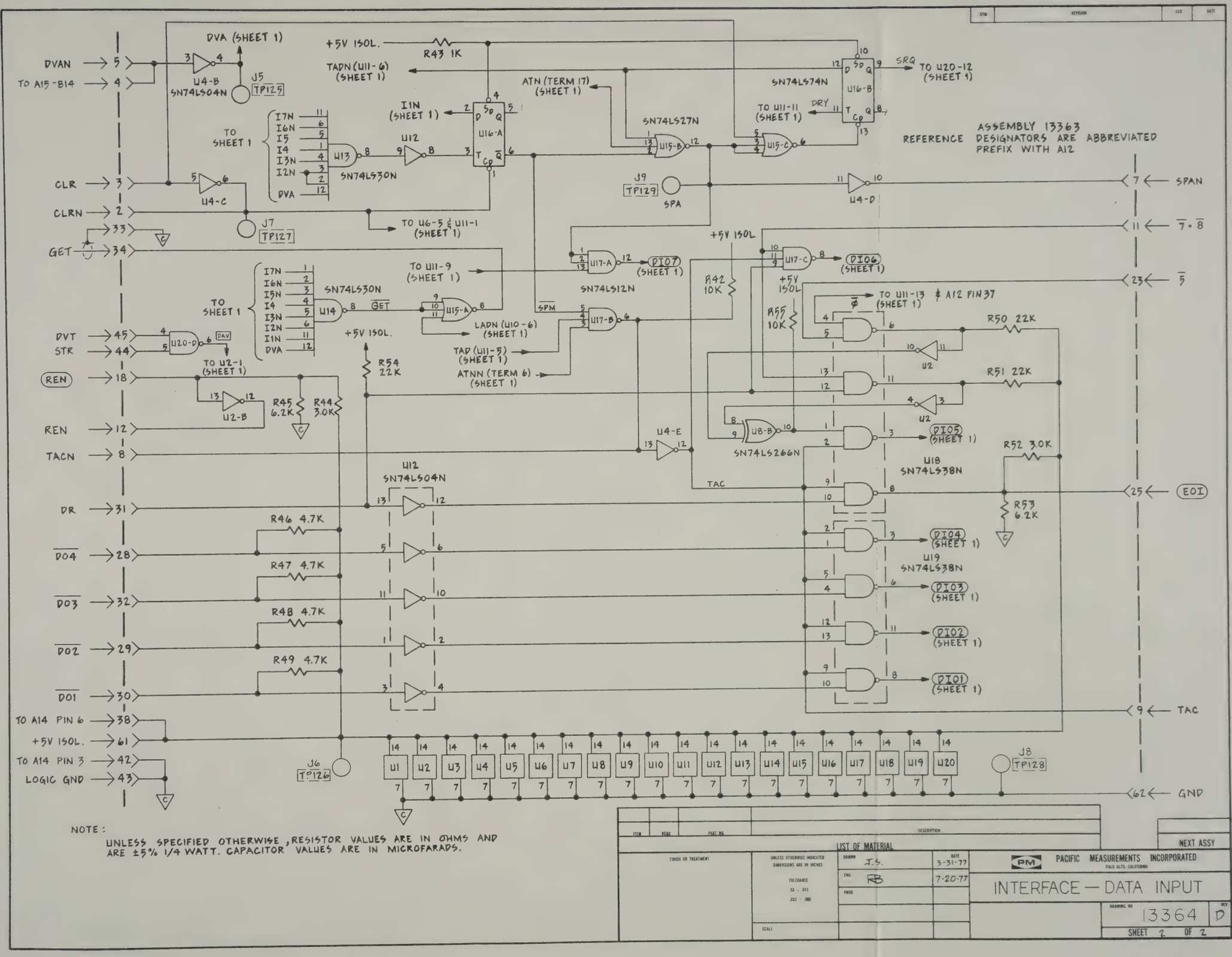


Figure A-3 Interface-Data Input




SYM
REVISION
ECO
DATE
DVAN
TO A15-B14
SRQ
TO U20-12
(SHEET 1)
ASSEMBLY 13363
REFERENCE DESIGNATORS ARE ABBREVIATED
PREFIX WITH A12
CLR
CLRN
GET
7 ← SPAN
11 ← $\overline{7} \cdot \overline{8}$
23 ← $\overline{5}$
TO U11-13 & A12 PIN 37
(SHEET 1)
R50 22K
DVT
STR
U2
R51 22K
REN
U2
REN
DI05
(SHEET 1)
R52 3.0K
TACN
U18
SN74LS38N
25 ← EOI
R53
6.2K
DR
DI04
(SHEET 1)
$\overline{DO4}$
U19
SN74LS38N
DI03
(SHEET 1)
$\overline{DO3}$
DI02
(SHEET 1)
$\overline{DO2}$
DI01
(SHEET 1)
$\overline{DO1}$
9 ← TAC
TO A14 PIN 4
+5V ISOL
TO A14 PIN
LOGIC GN
U18
U19
U20
J8
TP128
62 ← GND
N
DESCRIPTION
NEXT ASSY
ERIAL
DATE
3-31-77
7-20-77
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA
INTERFACE — DATA INPUT
DRAWING NO
13364
REV
D
SHEET 2 OF 2



NOTE:

UNLESS SPECIFIED OTHERWISE, RESISTOR VALUES ARE IN OHMS AND ARE ±5% 1/4 WATT. CAPACITOR VALUES ARE IN MICROFARADS.

ITEM	REQD	PART NO.	DESCRIPTION
			LIST OF MATERIAL

NEXT ASSY

FINISH OR TREATMENT

UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE
XX ± .015
XXX ± .005

SCALE

		DATE
DRAWN	J.S.	3-31-77
ENG	RB	7-20-77
PROD		

PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA

INTERFACE — DATA INPUT

DRAWING NO 13364 REV D

SHEET 2 OF 2

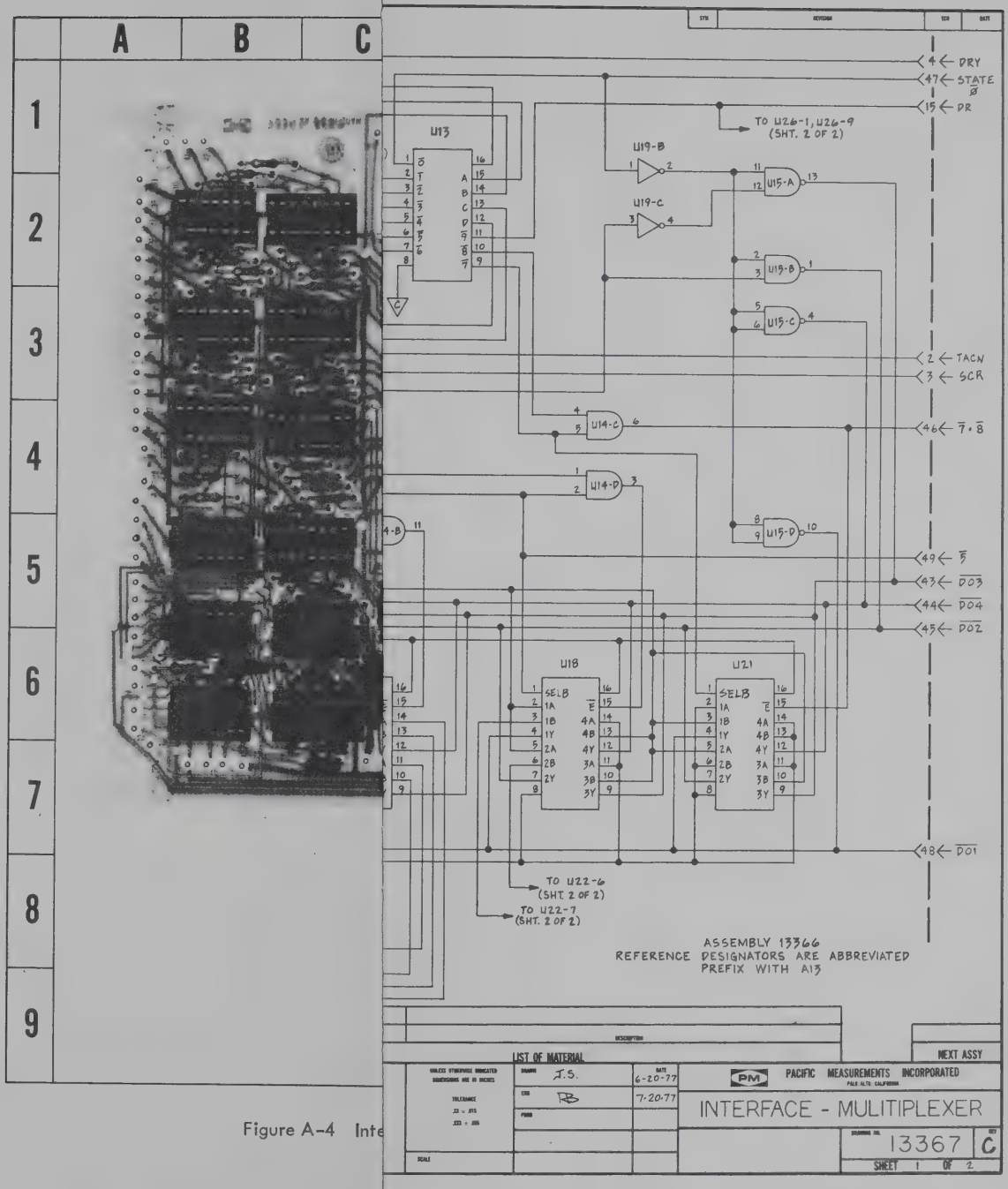


Figure A-4 Inte

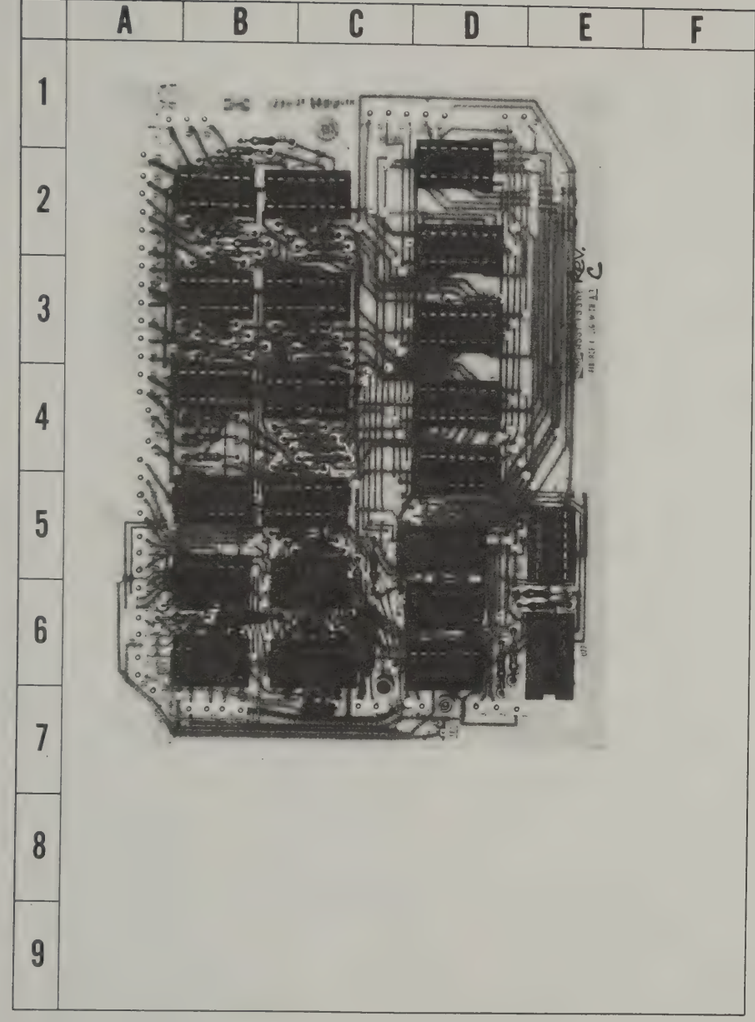
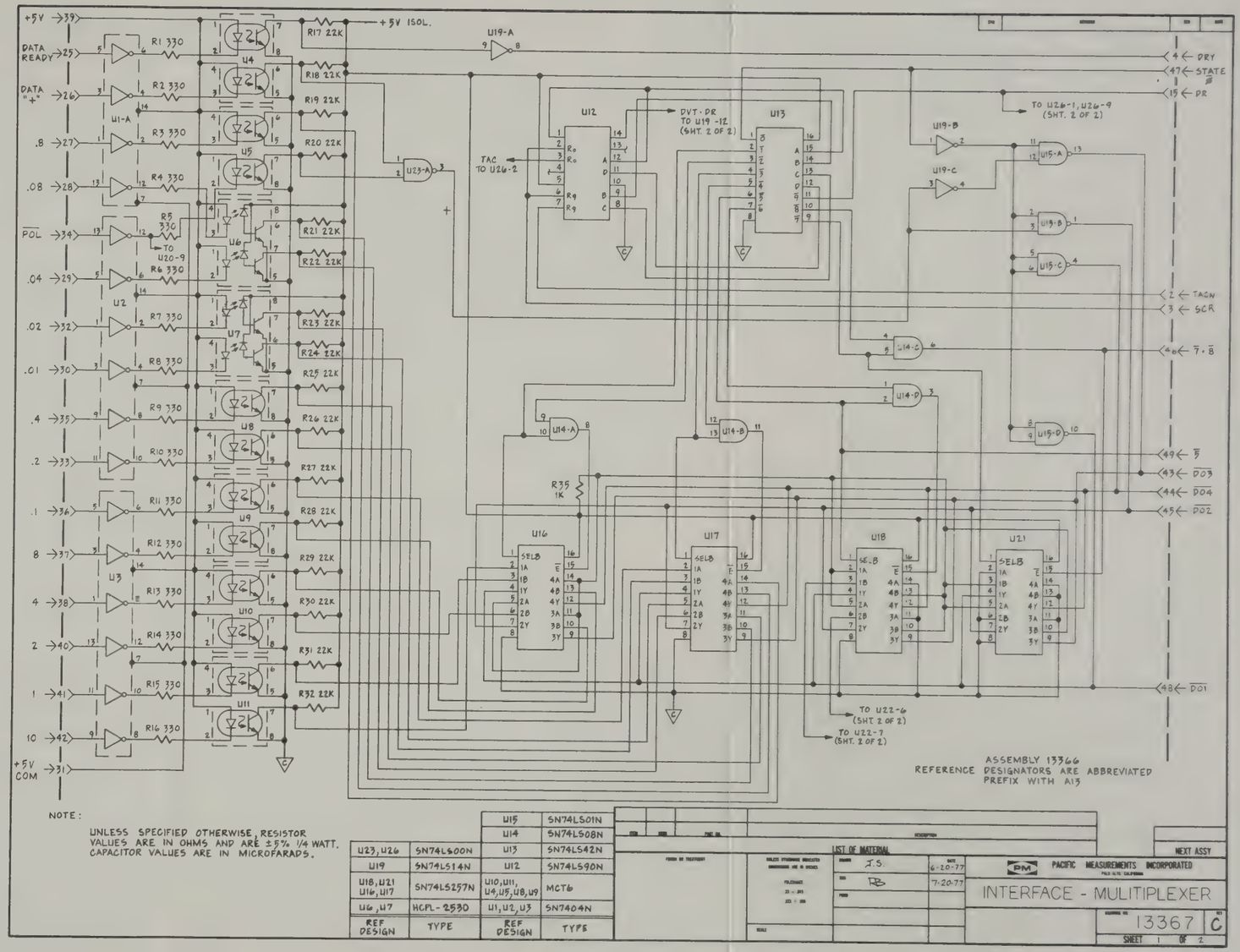


Figure A-4 Interface-Multiplexer



NOTE:

UNLESS SPECIFIED OTHERWISE, RESISTOR VALUES ARE IN OHMS AND ARE ±5% 1/4 WATT. CAPACITOR VALUES ARE IN MICROFARADS.

REF DESIGN	TYPE	REF DESIGN	TYPE
U23, U26	SN74LS00N	U15	SN74LS01N
U19	SN74LS14N	U14	SN74LS08N
U18, U21 U16, U17	SN74LS257N	U13	SN74LS42N
U6, U7	HCPL-2530	U12	SN74LS90N
REF DESIGN	TYPE	U10, U11, U4, U5, U8, U9	MCT6
		U1, U2, U3	SN7404N

LIST OF MATERIAL

DRAWN	J.S.	6-20-77
CHK	RB	7-20-77

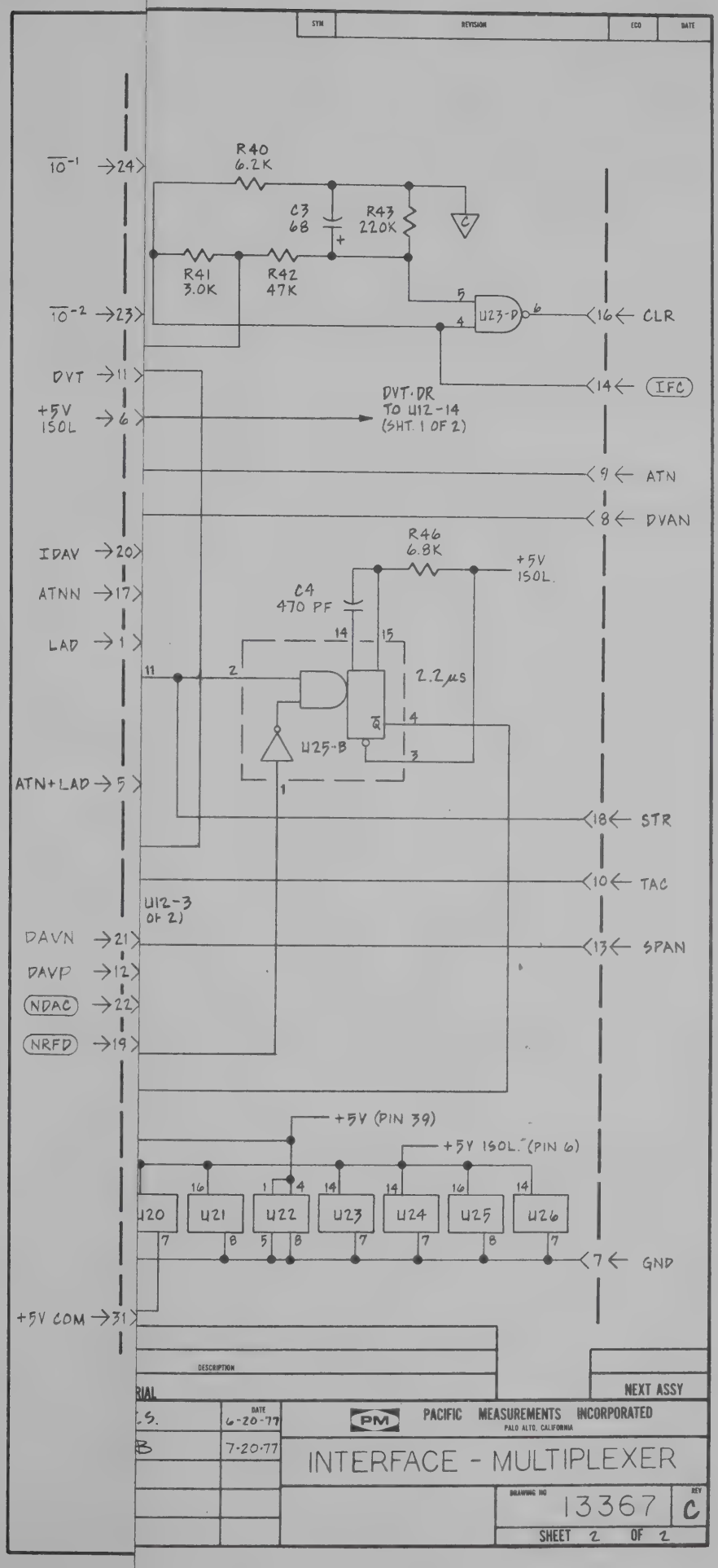
NEXT ASSY

PACIFIC MEASUREMENTS INCORPORATED

INTERFACE - MULITIPLEXER

13367 C

SHEET 1 OF 2


SYM
REVISION
ECO
DATE
$\overline{IO}^{-1}$ →24
R40
6.2K
C3
68
R43
220K
R41
3.0K
R42
47K
$\overline{IO}^{-2}$ →23
U23-D
16 ← CLR
DVT →11
14 ← IFC
DVT·DR
TO U12-14
(SHT. 1 OF 2)
+5V
ISOL →6
9 ← ATN
8 ← DVAN
IDAV →20
R46
6.8K
+5V
ISOL.
ATNN →17
C4
470 PF
LAD →1
2.2μs
U25-B
ATN+LAD →5
18 ← STR
10 ← TAC
U12-3
OF 2)
DAVN →21
13 ← SPAN
DAVP →12
NDAC →22
NRFD →19
+5V (PIN 39)
+5V ISOL. (PIN 6)
U20
U21
U22
U23
U24
U25
U26
7 ← GND
+5V COM →31
DESCRIPTION
NEXT ASSY
DATE
6-20-77
7-20-77
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA
INTERFACE - MULTIPLEXER
DRAWING NO
13367
REV
C
SHEET 2 OF 2

REFERENCE ASSEMBLY 13366 DESIGNATORS ARE ABBREVIATED PREFIX WITH A13

NOTE:

UNLESS SPECIFIED OTHERWISE, RESISTOR VALUES ARE IN OHMS AND ARE ±5% 1/4 WATT. CAPACITOR VALUES ARE IN MICROFARADS.

REF DESIGN	TYPE
U19	SN74LS14N
U25	SN74LS221N
U24	SN74LS74N
U22	MCT6
U20	SN74LS02N

LIST OF MATERIAL

ITEM	REQD	PART NO.	DESCRIPTION

NEXT ASSY

FINISH OR TREATMENT

UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE
XX ± .015
XXX ± .005

SCALE

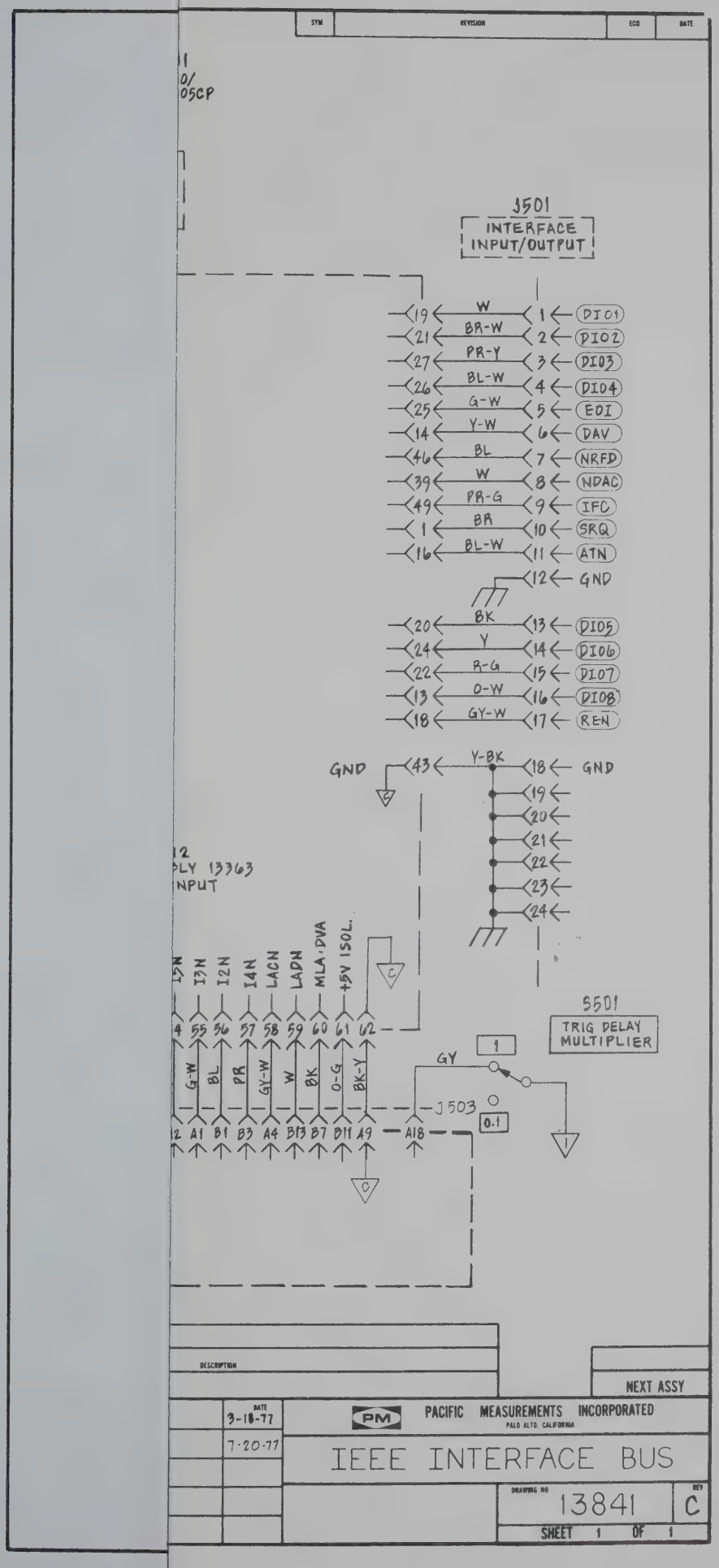
		DATE
DRAWN	J.S.	6-20-77
ENG	RB	7-20-77
PROD		

PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA

INTERFACE - MULTIPLEXER

DRAWING NO 13367 REV C

SHEET 2 OF 2


SYM
REVISION
ECO
DATE
J501
INTERFACE
INPUT/OUTPUT
19 W 1 DIO1
21 BR-W 2 DIO2
27 PR-Y 3 DIO3
26 BL-W 4 DIO4
25 G-W 5 EOI
14 Y-W 6 DAV
46 BL 7 NRFD
39 W 8 NDAC
49 PR-G 9 IFC
1 BR 10 SRQ
16 BL-W 11 ATN
12 GND
20 BK 13 DIO5
24 Y 14 DIO6
22 R-G 15 DIO7
13 O-W 16 DIO8
18 GY-W 17 REN
GND 43 Y-BK 18 GND
19
20
21
22
23
24
LY 13363
NPUT
I2N
I3N
I2N
I4N
LACN
LADN
MLA·DVA
+5V ISOL.
55 56 57 58 59 60 61 62
G-W
BL
PR
GY-W
W
BK
O-G
BK-Y
J503
A1 B1 B3 A4 B13 B7 B11 A9 A18
5501
TRIG DELAY
MULTIPLIER
GY
1
0.1
DESCRIPTION
NEXT ASSY
DATE
3-18-77
7-20-77
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA
IEEE INTERFACE BUS
DRAWING NO
13841
REV
C
SHEET 1 OF 1

A11 ASSEMBLY 13345
3-DIGIT LED DIGITAL DISPLAY

A14 ASSEMBLY 13506

120 VAC — T1 — 8.7V — CR1 PE-10 — C1 4000μF — U501 LM340/MC7805CP — C2 100μF — +5V ISOL.

J501
INTERFACE INPUT/OUTPUT

.01	16	O-W	30
.02	17	Y	32
.04	18	BR-W	29
.08	19	BL-W	28
.1	20	BR	36
.2	21	BL	33
.4	22	W	35
.8	23	GY	27
1	24	BR-Y	41
2	25	O-W	40
4	26	G-W	38
8	27	Y	37
10	28	G-Y	42
DATA READY	9	G	25
"+"	30	BR	26
+5V	6	O	39
+5V COM	35	BK-W	31
$\overline{POL}$	31	G	34
D.P. 10^{-1}	34	BL	24
D.P. 10^{-2}	33	Y-W	23
D.P. 10^{-3}	32	N.C.	
"−"	29	N.C.	

A13
ASSEMBLY 13366
MULTIPLEXER

CLR	16	O-W	3
DVAN	8	G-W	5
ATNN	17	BL-W	6
SPAN	13	PR-Y	7
TACN	2	GY-W	8
TAC	10	W	9
LAD	1	BK	10
$\overline{7}\cdot\overline{8}$	46	BR	11
IDAV	20	G	15
ATN	9	PR	17
$\overline{5}$	49	O-W	23
$\overline{DO4}$	44	GY-W	28
$\overline{DO2}$	45	W	29
$\overline{DO1}$	48	BK	30
DR	15	BR	31
$\overline{DO3}$	43	R-Y	32
DRY	4	G	35
SCR	3	BL	36
STATE $\overline{P}$	47	PR	37
NDAC	22	BK	40
DAVN	21	BR-W	41
STR	18	Y	44
DVT	11	G	45
NRFD	19	PR-Y	47
ATN+LAD	5	GY	48
IFC	14	BK	50

A12
ASSEMBLY 13363
DATA INPUT

19	W	1	DIO1
21	BR-W	2	DIO2
27	PR-Y	3	DIO3
26	BL-W	4	DIO4
25	G-W	5	EOI
14	Y-W	6	DAV
46	BL	7	NRFD
39	W	8	NDAC
49	PR-G	9	IFC
1	BR	10	SRQ
16	BL-W	11	ATN
		12	GND
20	BK	13	DIO5
24	Y	14	DIO6
22	R-G	15	DIO7
13	O-W	16	DIO8
18	GY-W	17	REN
GND	43	18	GND
		19	
		20	
		21	
		22	
		23	
		24	

A7
ASSEMBLY 13342
3 DIGIT DISPLAY LOGIC

TRIGGER DELAY A5

S501
TRIG DELAY MULTIPLIER

J503

NOTE:
1. A6C31 IS REMOVED.
2. DISCONNECT A6-18 AND REMOVE JUMPER BETWEEN A6-5 & A6-38.
3. INSTALL A6R47.

A6
ASSEMBLY 13522
TRIGGER CIRCUIT

R47 4.99K

A15
ASSEMBLY 14091
PROGRAMABLE DELAY

TRIG PULSE OUTPUT — J501

LIST OF MATERIAL

ITEM	REQD	PART NO.	DESCRIPTION		NEXT ASSY
FINISH OR TREATMENT		UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES TOLERANCE XX ± .015 XXX ± .005	DRAWN YD	DATE 9-18-77	PACIFIC MEASUREMENTS INCORPORATED PALO ALTO CALIFORNIA
			ENG RB	7-20-77	IEEE INTERFACE BUS
			PROD		DRAWING NO 13841 REV C
		SCALE			SHEET 1 OF 1

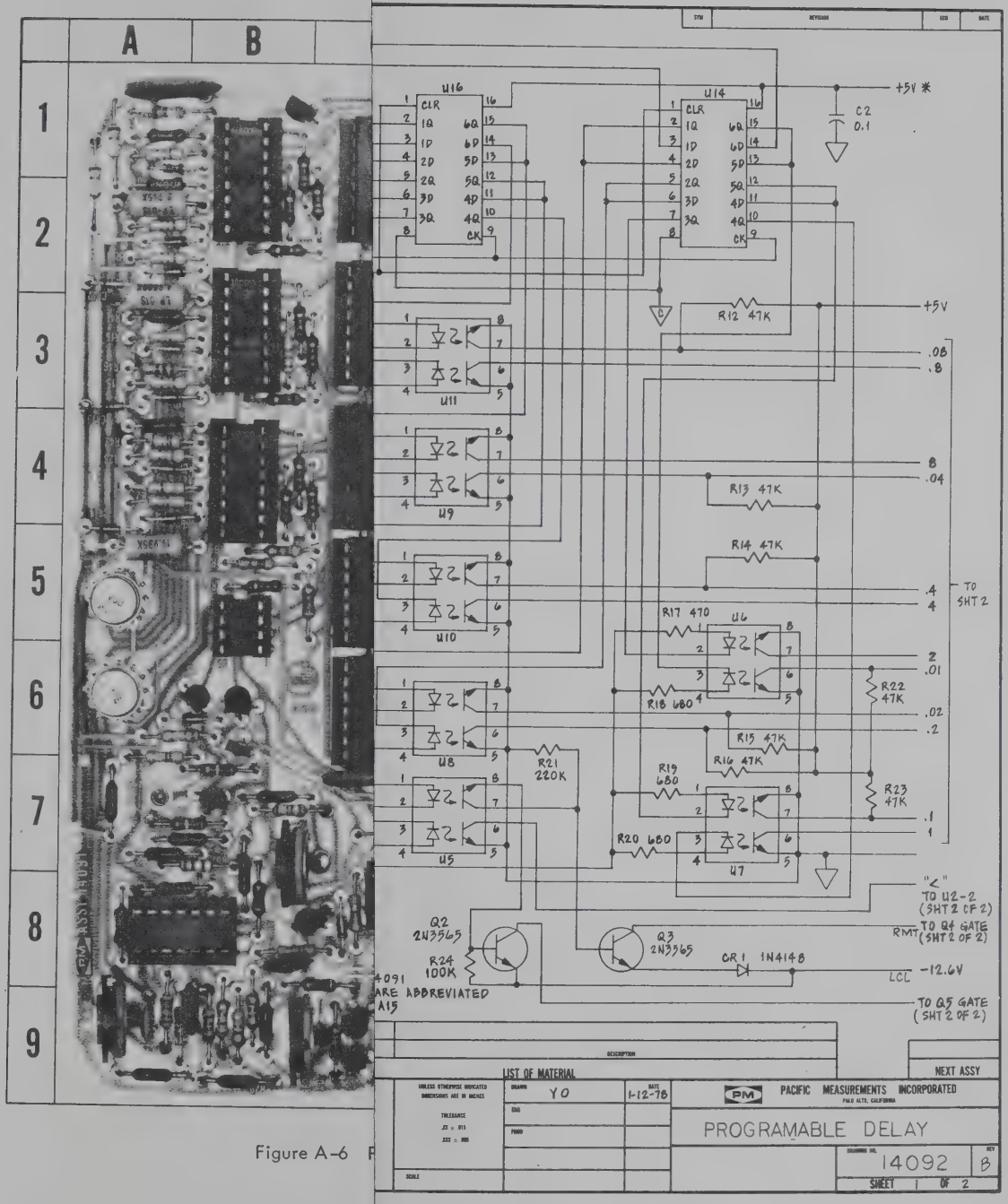

A
B
1
2
3
4
5
6
7
8
9
U16
U14
+5V *
C2
0.1
R12 47K
+5V
.08
.8
U11
8
.04
U9
R13 47K
R14 47K
.4
4
TO SHT 2
U10
R17 470
U6
2
.01
R18 680
R22 47K
.02
.2
R15 47K
R16 47K
U8
R21 220K
R19 680
R23 47K
.1
1
R20 680
U7
U5
"<" TO U2-2 (SHT 2 OF 2)
RMT
TO Q4 GATE (SHT 2 OF 2)
Q2 2N3565
Q3 2N3565
R24 100K
CR1 1N4148
LCL
-12.6V
4091 ARE ABBREVIATED A15
TO Q5 GATE (SHT 2 OF 2)
DESCRIPTION
LIST OF MATERIAL
NEXT ASSY
UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE
DRAWN
Y O
DATE
1-12-78
ENG
PROD
SCALE
PM
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA
PROGRAMABLE DELAY
DRAWING NO.
14092
REV
B
SHEET 1 OF 2

Figure A-6 P

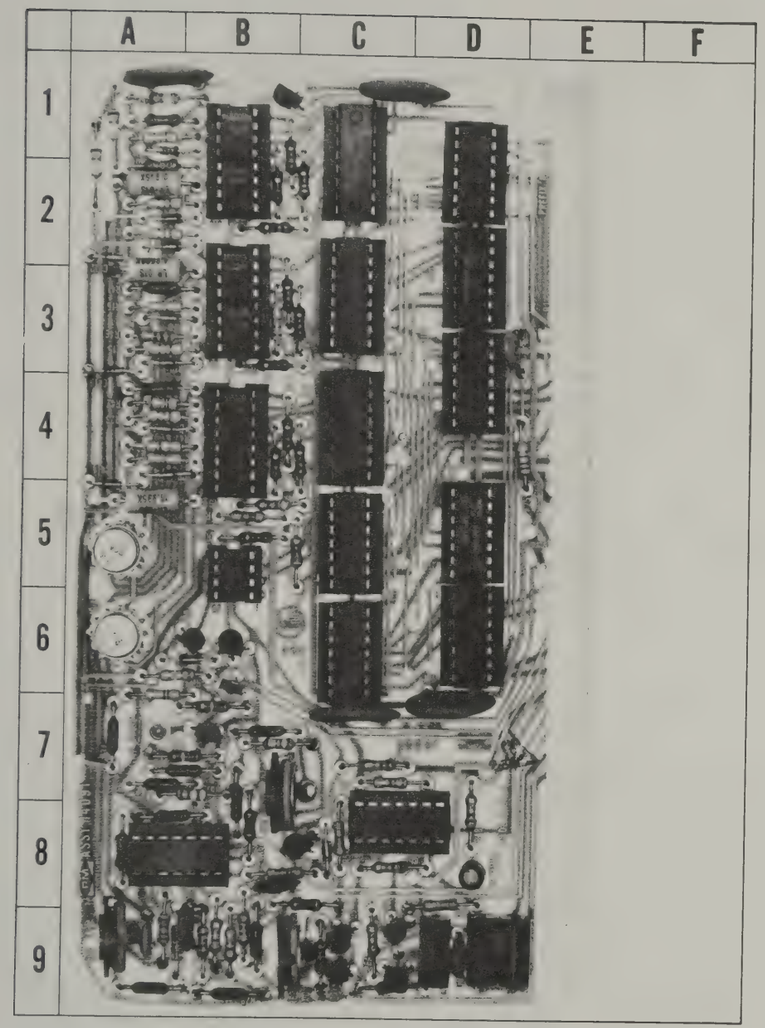
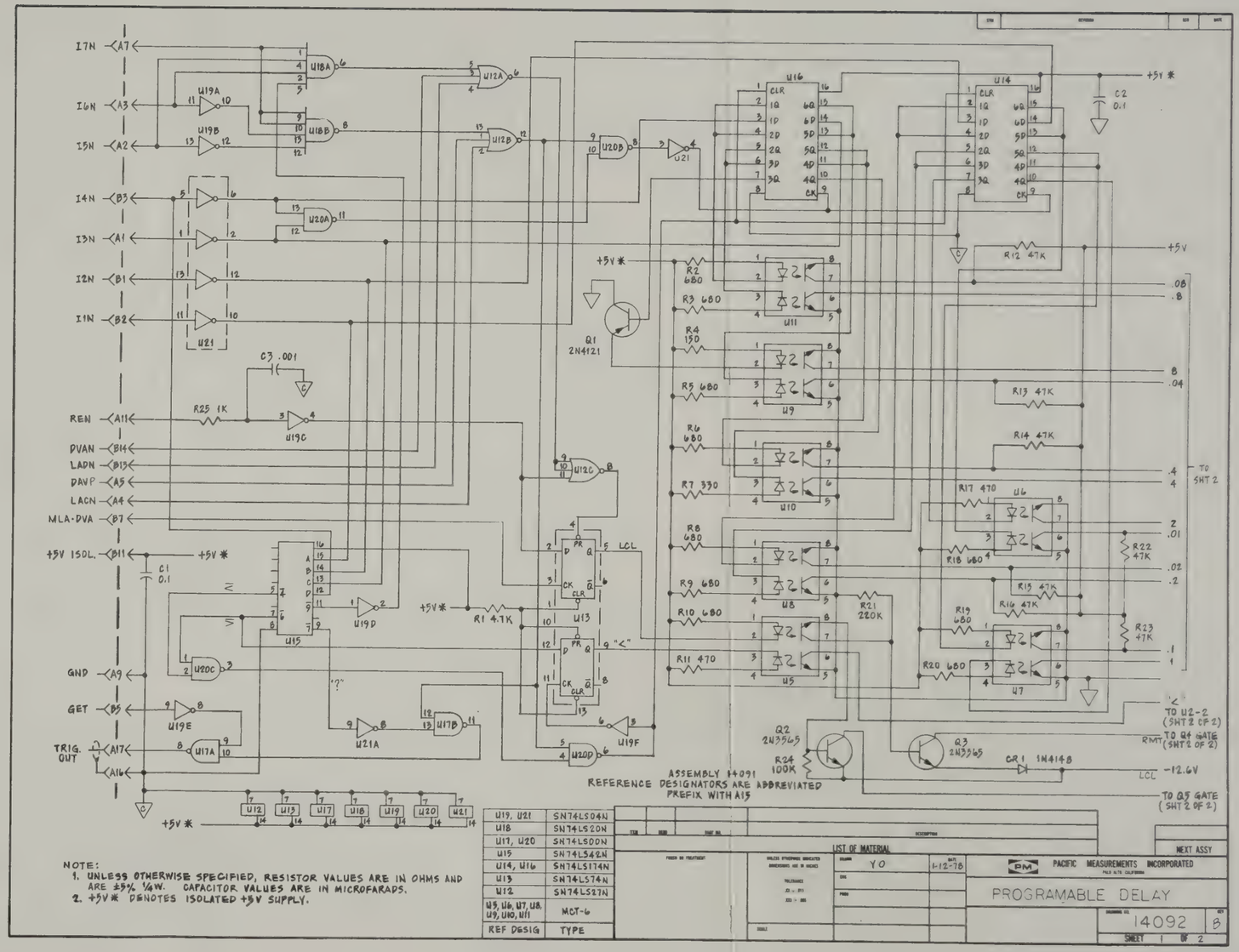


Figure A-6 Programmable Delay



NOTE:
1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS AND ARE ±5% ¼W. CAPACITOR VALUES ARE IN MICROFARADS.
2. +5V* DENOTES ISOLATED +5V SUPPLY.

REF DESIG	TYPE
U19, U21	SN74LS04N
U18	SN74LS20N
U17, U20	SN74LS00N
U15	SN74LS42N
U14, U16	SN74LS174N
U13	SN74LS74N
U12	SN74LS27N
U5, U6, U7, U8, U9, U10, U11	MCT-6

ASSEMBLY 14091
REFERENCE DESIGNATORS ARE ABBREVIATED PREFIX WITH A15

LIST OF MATERIAL

NEXT ASSY

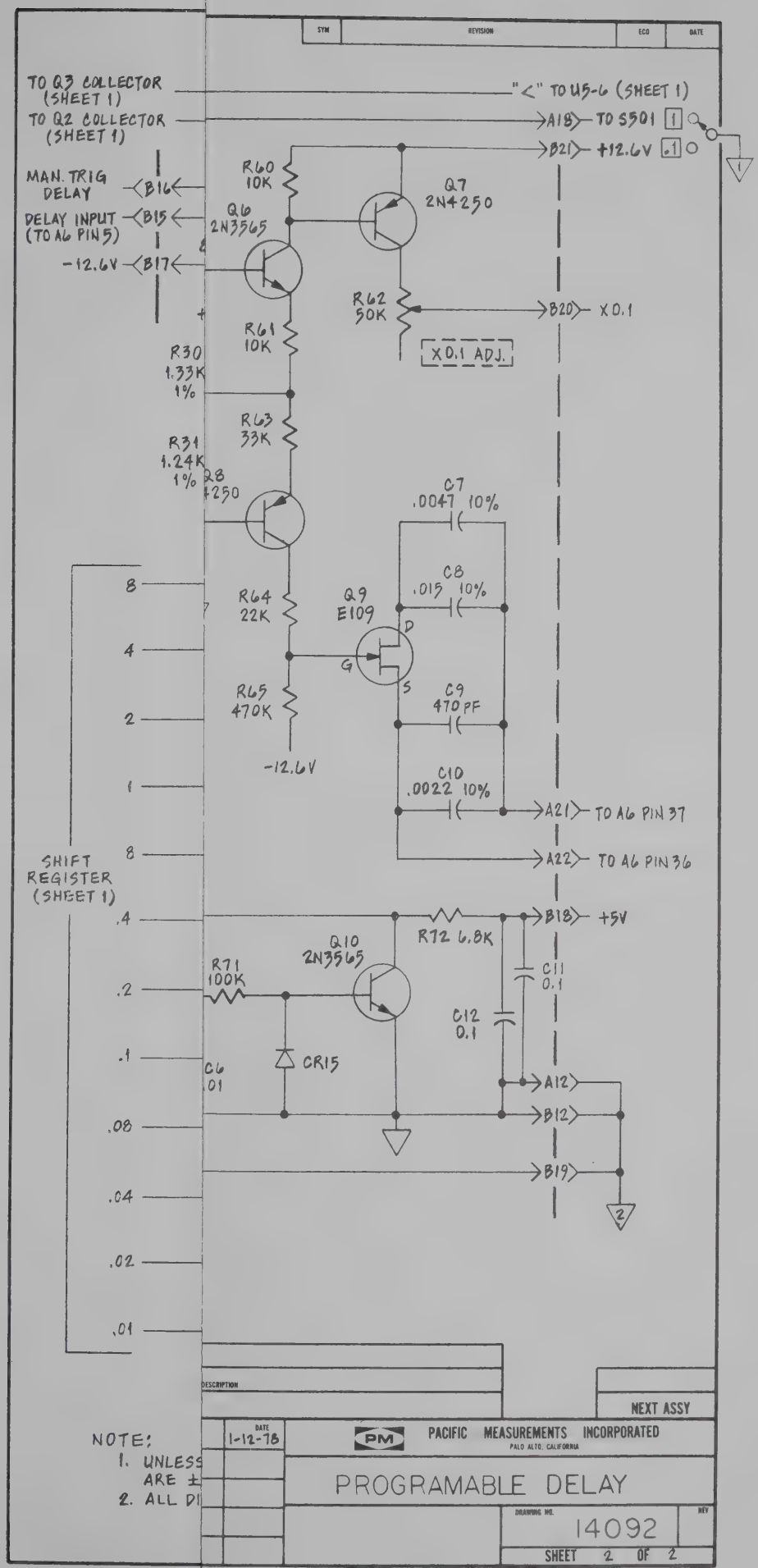
YO 1-12-78

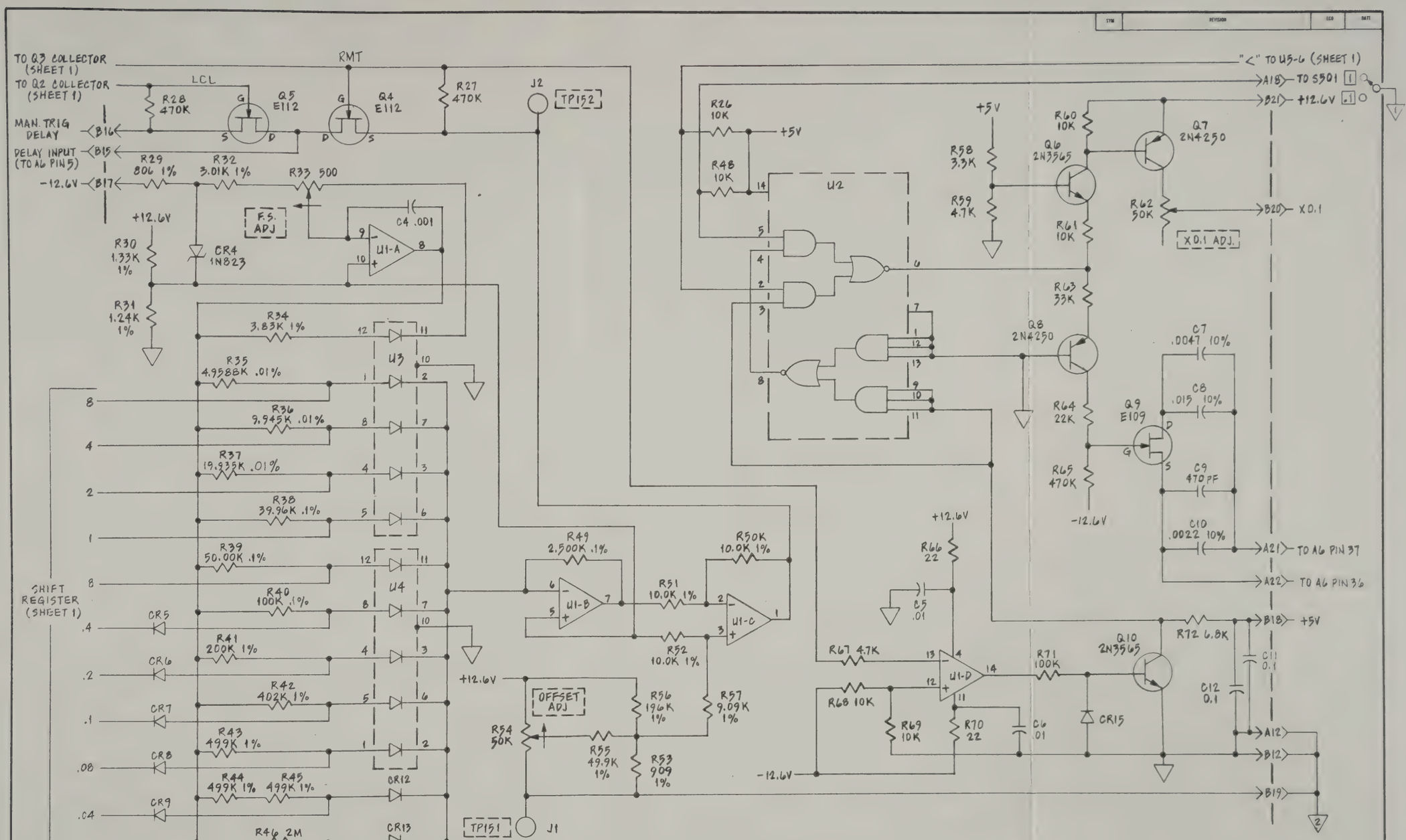
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO CALIFORNIA

PROGRAMABLE DELAY

14092 B

SHEET 1 OF 2


SYM
REVISION
ECO
DATE
TO Q3 COLLECTOR (SHEET 1)
"<" TO U5-6 (SHEET 1)
TO Q2 COLLECTOR (SHEET 1)
A18 TO S501 1
B21 +12.6V .1
MAN. TRIG DELAY
B16
DELAY INPUT (TO A6 PIN 5)
B15
-12.6V
B17
R60 10K
Q6 2N3565
Q7 2N4250
R62 50K
B20 X0.1
X0.1 ADJ.
R61 10K
R30 1.33K 1%
R63 33K
R31 1.24K 1%
Q8 2N4250
C7 .0047 10%
C8 .015 10%
R64 22K
Q9 E109
D
G
S
R65 470K
C9 470 PF
-12.6V
C10 .0022 10%
A21 TO A6 PIN 37
A22 TO A6 PIN 36
SHIFT REGISTER (SHEET 1)
8
4
2
1
8
.4
.2
.1
.08
.04
.02
.01
R72 6.8K
B18 +5V
Q10 2N3565
R71 100K
C11 0.1
C12 0.1
C6 .01
CR15
A12
B12
B19
2
DESCRIPTION
NEXT ASSY
NOTE:
1. UNLESS
ARE ±
2. ALL DI
DATE 1-12-78
PM
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA
PROGRAMABLE DELAY
DRAWING NO. 14092
REV
SHEET 2 OF 2



NOTE:
1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS AND ARE ±5% 1/4 W. CAPACITOR VALUES ARE IN MICROFARADS.
2. ALL DIODES ARE 1N4148.

REF DESIG	TYPE
U3, U4	CA3039
U2	SN74LS51N
U1	LM324N

ITEM	REQD	PART NO.	DESCRIPTION

LIST OF MATERIAL

NEXT ASSY

FINISH OR TREATMENT

UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE
XX - .015
XXX - .005

SCALE

DRAWN YO 1-12-78
ENG
PROD

PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA

PROGRAMABLE DELAY

DRAWING NO. 14092 REV

SHEET 2 OF 2

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PART NO.	TOT. QTY.
		CHASSIS ASSEMBLY - 13573		
J501		Connector, Recept, 24 pins	13677	
J502		Connector, BNC	10048	
J503		Connector, P.C. 44 pins	12738-001	
S501		Switch, Toggle	10057	
U501		LM340T	13479-1	

REPLACEABLE PARTS LIST						
REF. DESIG.	LOCATION	DESCRIPTION			HP PART NO.	TOT. QTY.
		INTERFACE-DATA INPUT PC BOARD ASSEMBLY 13363 (Refer to Fig. A-3)				
A12J1	D-1	Test Jack, Yellow			10140-2	7
A12J2	A-3	Test Jack, Yellow			10140-2	Ref
A12J3	A-3	Test Jack, Yellow			10140-2	Ref
A12J4	E-7	Test Jack, Yellow			10140-2	Ref
A12J5	C-2	Test Jack, Yellow			10140-2	Ref
A12J6	C-6	Test Jack, Red			10140-1	1
A12J7	C-1	Test Jack, Yellow			10140-2	Ref
A12J8	C-7	Test Jack, Black			10140-3	1
A12J9	C-5	Test Jack, Yellow			10140-2	Ref
A12R1	D-1	Res., Car. Film. 3.0KΩ	±5%	1/4W	10013-75	15
A12R2	D-2	Res., Car. Film. 6.2KΩ	±5%	1/4W	10013-76	15
A12R3	D-3	Res., Car. Film. 3.0KΩ	±5%	1/4W	10013-75	Ref
A12R4	D-3	Res., Car. Film. 6.2KΩ	±5%	1/4W	10013-76	Ref
A12R5	D-4	Res., Car. Film. 3.0KΩ	±5%	1/4W	10013-75	Ref
A12R6	D-4	Res., Car. Film. 6.2KΩ	±5%	1/4W	10013-76	Ref
A12R7	D-2	Res., Car. Film. 3.0KΩ	±5%	1/4W	10013-75	Ref
A12R8	D-2	Res., Car. Film. 6.2KΩ	±5%	1/4W	10013-76	Ref
A12R9	D-3	Res., Car. Film. 3.0KΩ	±5%	1/4W	10013-75	Ref
A12R10	D-3	Res., Car. Film. 6.2KΩ	±5%	1/4W	10013-76	Ref
A12R11	D-4	Res., Car. Film. 3.0KΩ	±5%	1/4W	10013-75	Ref
A12R12	D-4	Res., Car. Film. 6.2KΩ	±5%	1/4W	10013-76	Ref
A12R13	D-3	Res., Car. Film. 3.0KΩ	±5%	1/4W	10013-75	Ref
A12R14	D-3	Res., Car. Film. 6.2KΩ	±5%	1/4W	10013-76	Ref
A12R15	D-2	Res., Car. Film. 3.0KΩ	±5%	1/4W	10013-75	Ref
A12R16	D-2	Res., Car. Film 6.2KΩ	±5%	1/4W	10013-76	Ref
A12R17	D-2	Res., Car. Film 3.0KΩ	±5%	1/4W	10013-75	Ref
A12R18	D-2	Res., Car. Film 6.2KΩ	±5%	1/4W	10013-76	Ref
A12R19	D-1	Res., Car. Film 3.0KΩ	±5%	1/4W	10013-75	Ref
A12R20	D-1	Res., Car. Film 6.2KΩ	±5%	1/4W	10013-76	Ref
A12R21	B-2	Res., Car. Film 3.3KΩ	±5%	1/4W	10013-31	2
A12R22	C-6	Res., Car. Film 1.0KΩ	±5%	1/4W	10013-25	3
A12R23	B-6	Res., Car. Film 3.3KΩ	±5%	1/4W	10013-31	Ref
A12R24	C-6	Res., Car. Film 1 KΩ	±5%	1/4W	10013-25	Ref
A12R25	B-6	Res., Car. Film 22KΩ	±5%	1/4W	10013-41	13
A12R26	B-6	Res., Car. Film 22KΩ	±5%	1/4W	10013-41	Ref
A12R27	B-6	Res., Car. Film 22KΩ	±5%	1/4W	10013-41	Ref
A12R28	B-5	Res., Car. Film 22KΩ	±5%	1/4W	10013-41	Ref
A12R29	B-5	Res., Car. Film 22KΩ	±5%	1/4W	10013-41	Ref
A12R30	B-2	Res., Car. Film 22KΩ	±5%	1/4W	10013-41	Ref
A12R31	B-4	Res., Car. Film 22KΩ	±5%	1/4W	10013-41	Ref
A12R32	B-4	Res., Car. Film 22KΩ	±5%	1/4W	10013-41	Ref
A12R33	B-1	Res., Car. Film 22KΩ	±5%	1/4W	10013-41	Ref
A12R34	B-3	Res., Car. Film 22KΩ	±5%	1/4W	10013-41	Ref
A12R35	B-2	Res., Car. Film 3.0KΩ	±5%	1/4W	10013-75	Ref
A12R36	B-6	Res., Car. Film 3.0KΩ	±5%	1/4W	10013-75	Ref
A12R37	C-6	Res., Car. Film 6.2KΩ	±5%	1/4W	10013-76	Ref
A12R38	B-7	Res., Car. Film 3.0KΩ	±5%	1/4W	10013-75	Ref
A12R39	B-7	Res., Car. Film 6.2KΩ	±5%	1/4W	10013-76	Ref
A12R40	C-1	Res., Car. Film 6.2KΩ	±5%	1/4W	10013-76	Ref
A12R41	---	Not Used			--------	---
A12R42	D-1	Res., Car. Film 10KΩ	±5%	1/4W	10013-37	2
A12R43	D-4	Res., Car. Film 1.0KΩ	±5%	1/4W	10013-25	Ref
A12R44	D-2	Res., Car. Film 3.0KΩ	±5%	1/4W	10013-75	Ref

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PM PART NO.	TOT. QTY.
A12R45	D-3	Res., Car. Film. 6.2KΩ ±5% 1/4W	10013-76	Ref
A12R46	D-6	Res., Car. Film. 4.7KΩ ±5% 1/4W	10013-33	4
A12R47	D-7	Res., Car. Film. 4.7KΩ ±5% 1/4W	10013-33	Ref
A12R48	E-6	Res., Car. Film. 4.7KΩ ±5% 1/4W	10013-33	Ref
A12R49	E-7	Res., Car. Film. 4.7KΩ ±5% 1/4W	10013-33	Ref
A12R50	D-1	Res., Car. Film. 22KΩ ±5% 1/4W	10013-41	Ref
A12R51	D-1	Res., Car. Film. 22KΩ ±5% 1/4W	10013-41	Ref
A12R52	D-5	Res., Car. Film. 3.0KΩ ±5% 1/4W	10013-75	Ref
A12R53	D-6	Res., Car. Film. 6.2KΩ ±5% 1/4W	10013-76	Ref
A12R54	D-7	Res., Car. Film. 22KΩ ±5% 1/4W	10013-41	Ref
A12R55	5-E	Res., Car. Film. 10KΩ ±5% 1/4W	10013-37	Ref
A12U1	D-3	IC SN74 LS14N	13470-7	2
A12U2	D-2	IC SN74 LS14N	13470-7	Ref
A12U3	C-3	IC SN74LS04N	13470-4	3
A12U4	C-2	IC SN74LS04N	13470-4	Ref
A12U5	B-2	IC SN74LS30N	13470-10	3
A12U6	B-3	IC SN74LS10N	13470-6	1
A12U7	B-4	IC SN74LS266N	13470-22	3
A12U8	B-4	IC SN74LS266N	13470-22	Ref
A12U9	B-5	IC SN74LS266N	13470-22	Ref
A12U10	B-3	IC SN74LS27N	13470-9	2
A12U11	C-6	IC SN74LS74N	13470-13	2
A12U12	D-7	IC SN74LS04N	13470-4	Ref
A12U13	C-4	IC SN74LS30N	13470-10	Ref
A12U14	B-5	IC SN74LS30N	13470-10	Ref
A12U15	C-5	IC SN74LS27N	13470-9	Ref
A12U16	C-5	IC SN74LS74N	13470-13	Ref
A12U17	D-5	IC SN74LS12N	13470-26	1
A12U18	D-5	IC SN74LS38N	13470-11	3
A12U19	D-6	IC SN74LS38N	13470-11	Ref
A12U20	C-7	IC SN74LS38N	13470-11	Ref
A12S1	C-1	Switch Rocker Arms, 7 Contact Dip	13475	2
A12S2	B-6	Switch Rocker Arms, 7 Contact Dip	13475	Ref
		IC Sockets 14 Pin	10978-1	22
		Connector Pins	10600	61

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PM PART NO.	TOT. QTY.
		INTERFACE-MULTIPLEXER PC BOARD ASSEMBLY 13366 (Refer to Fig. A-4)		
A13C1	C-6	Cap., Cer., 0.1μ F +80% - 20% 100VDC	10000-10	1
A13C2	C-7	Cap., Cer., 220pF ±20% 1000VDC	10000-2	1
A13C3	B-6	Cap., Tan., 68μ F ±20% 15VDC	10787-4	1
A13C4	C-6	Cap., Cer., 470pF ±20% 1000VDC	10000-3	1
A13J1	D-7	Test Jack, Yellow	10140-2	2
A13J2	C-7	Test Jack, Yellow	10140-2	Ref
A13R1	B-4	Res., Car. Film 330Ω ±5% 1/4W	10013-19	18
A13R2	B-4	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R3	B-4	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R4	B-3	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R5	B-4	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R6	B-3	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R7	B-3	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R8	B-3	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R9	B-9	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R10	B-3	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R11	B-9	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R12	B-9	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R13	B-9	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R14	B-2	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R15	B-2	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R16	B-1	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R17	C-5	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	18
A13R18	C-5	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R19	B-5	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R20	C-5	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R21	C-4	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R22	C-4	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R23	C-4	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R24	C-4	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R25	C-3	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R26	C-3	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R27	C-3	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R28	B-3	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R29	C-2	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R30	C-2	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R31	C-2	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R32	B-2	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R33	----	Not Used	-------	---
A13R34	----	Not Used	-------	---
A13R35	D-3	Res., Car. Film 1KΩ ±5% 1/4W	10013-25	2
A13R36	E-6	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R37	E-6	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	Ref
A13R38	D-6	Res., Car. Film 330KΩ ±5% 1/4W	10013-19	Ref
A13R39	D-6	Res., Car. Film 330Ω ±5% 1/4W	10013-19	Ref
A13R40	B-6	Res., Car. Film 6.2KΩ ±5% 1/4W	10013-76	1
A13R41	A-6	Res., Car. Film 3.0KΩ ±5% 1/4W	10013-75	1
A13R42	B-6	Res., Car. Film 47KΩ ±5% 1/4W	10013-45	1
A13R43	B-6	Res., Car. Film 220KΩ ±5% 1/4W	10013-53	1
A13R44	C-7	Res., Car. Film 68KΩ ±5% 1/4W	10013-47	1
A13R45	C-6	Res., Car. Film 1.0KΩ ±5% 1/4W	10013-25	Ref
A13R46	C-6	Res., Car. Film 6.8KΩ ±5% 1/4W	10013-35	1

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	DM PART NO.	TOT. QTY.
A13U1	B-4	IC SN7404N	11270-2	3
A13U2	B-3	IC SN7404N	11270-2	Ref
A13U3	B-2	IC SN7404N	11270-2	Ref
A13U4	B-5	IC MCT6	13476	7
A13U5	C-5	IC MCT6	13476	Ref
A13U6	B-4	IC HCPL-2530	13644	2
A13U7	C-4	IC HCPL-2530	13644	Ref
A13U8	B-3	IC MCT6	13476	Ref
A13U9	C-3	IC MCT6	13476	Ref
A13U10	B-2	IC MCT6	13476	Ref
A13U11	C-2	IC MCT6	13476	Ref
A13U12	D-6	IC SN74LS90N	13470-15	1
A13U13	D-5	IC SN74LS42N	13470-12	1
A13U14	D-2	IC SN74LS08N	13470-5	1
A13U15	E-5	IC SN74LS01N	13470-2	1
A13U16	D-3	IC SN74LS257N	13470-20	4
A13U17	D-4	IC SN74LS257N	13470-20	Ref
A13U18	D-4	IC SN74LS257N	13470-20	Ref
A13U19	D-6	IC SN74LS14N	13470-7	1
A13U20	B-5	IC SN74LS02N	13470-3	1
A13U21	D-2	IC SN74LS257N	13470-20	Ref
A13U22	E-6	IC MCT6	13476	Ref
A13U23	B-5	IC SN74LS00N	13470-1	2
A12U24	C-6	IC SN74LS74N	13470-13	1
A13U25	C-6	IC SN74LS221N	13470-18	1
A13U26	B-6	IC SN74LS00N	13470-1	Ref
		IC Sockets 14 Pins	10978-1	11
		IC Sockets 16 Pins	10978-2	11
		Connector Pins	10600	49

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PM PART NO.	TOT. QTY.
		AUXILIARY +5V POWER SUPPLY 13506 (Refer Fig. A-5)		
A14C1	D&E-3	Cap, Electrolytic 400µ F 15VDC	10003-3	1
A14C2	C-2	Cap, Tantalum 100µ F 20VDC	10787-10	1
A14CR1	E-2	Bridge Rectifier ED1 PE-10	12409	1
		Pin, Connector	10600	7

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PM PART NO.	TOT. QTY.
		PROGRAMMABLE DELAY PC BOARD ASSEMBLY 14091 (Refer to Fig. A-6)		
A15C1	D-6	Cap., Cer., 0.1μ F +80%-20% 100V	10000-10	4
A15C2	C-1	Cap., Cer., 0.1μ F +80%-20% 100V	10000-10	Ref
A15C3	D-3	Cap., Cer., .001μ F ±20% 1000V	10000-4	2
A15C4	A-9	Cap., Cer., .001μ F ±20% 1000V	10000-4	Ref
A15C5	B-8	Cap., Cer., .01μ F ±20% 100V	10000-11	2
A15C6	B-9	Cap., Cer., .01μ F ±20% 100V	10000-11	Ref
A15C7	D-9	Cap., Mylar .0047μ F ±10% 200V	10007-3	1
A15C8	E-9	Cap., Mylar .015μ F ±10% 200V	10007-13	1
A15C9	D-9	Cap., Cer., 470pF ±20% 1000V	10000-3	1
A15C10	D-9	Cap., Mylar .0022μ F ±10% 200V	10007-2	1
A15C11	C-7	Cap., Cer., 0.1μ F +80%-20% 200V	10000-10	Ref
A15C12	A-1	Cap., Cer., 0.1μ F +80%-20% 200V	10000-10	Ref
A15CR1	B-6	Diode, IN4148	10043	12
A15CR2	---	Not Used	-----	--
A15CR3	---	Not Used	-----	--
A15CR4	B-9	Diode, Zener IN823	10045	1
A15CR5	A-2	Diode, IN4148	10043	Ref
A15CR6	A-3	Diode, IN4148	10043	Ref
A15CR7	A-4	Diode, IN4148	10043	Ref
A15CR8	A-1	Diode, IN4148	10043	Ref
A15CR9	A-2	Diode, IN4148	10043	Ref
A15CR10	A-3	Diode, IN4148	10043	Ref
A15CR11	A-4	Diode, IN4148	10043	Ref
A15CR12	A-2	Diode, IN4148	10043	Ref
A15CR13	A-3	Diode, IN4148	10043	Ref
A15CR14	A-4	Diode, IN4148	10043	Ref
A15CR15	C-8	Diode, IN4148	10043	Ref
A15J1	D-8	Test Jack, Black	10140-3	1
A15J2	A-7	Test Jack, Yellow	10140-2	1
A15Q1	B-1	Transistor 2N4121	10398	1
A15Q2	B-6	Transistor 2N3565	10019	4
A15Q3	B-6	Transistor 2N3565	10019	Ref
A15Q4	B-7	Transistor E112	12591	2
A15Q5	B-6	Transistor E112	12591	Ref
A15Q6	C-9	Transistor 2N3565	10019	Ref
A15Q7	C-9	Transistor 2N4250	11119	2
A15Q8	D-9	Transistor 2N4250	11119	Ref
A15Q9	D-9	Transistor E109	12799	1
A15Q10	C-8	Transistor 2N3565	10019	Ref
A15R1	C-5	Res., Car. Film 4.7KΩ ±5% 1/4W	10013-33	3
A15R2	B-2	Res., Car. Film 680Ω ±5% 1/4W	10013-23	10
A15R3	B-1	Res., Car. Film 680Ω ±5% 1/4W	10013-23	Ref
A15R4	B-3	Res., Car. Film 150Ω ±5% 1/4W	10013-15	1
A15R5	B-3	Res., Car. Film 680Ω ±5% 1/4W	10013-23	Ref
A15R6	B-2	Res., Car. Film 680Ω ±5% 1/4W	10013-23	Ref
A15R7	C-2	Res., Car. Film 330Ω ±5% 1/4W	10013-19	1
A15R8	B-3	Res., Car. Film 680Ω ±5% 1/4W	10013-23	Ref
A15R9	C-2	Res., Car. Film 680Ω ±5% 1/4W	10013-23	Ref
A15R10	B-5	Res., Car. Film 680Ω ±5% 1/4W	10013-23	Ref

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	HP PART NO.	TOT. QTY.
A15R11	B-5	Res., Car. Film 470Ω ±5% 1/4W	10013-21	2
A15R12	A-1	Res., Car. Film 47KΩ ±5% 1/4W	10013-45	7
A15R13	A-2	Res., Car. Film 47KΩ ±5% 1/4W	10013-45	Ref
A15R14	A-2	Res., Car. Film 47KΩ ±5% 1/4W	10013-45	Ref
A15R15	A-3	Res., Car. Film 47KΩ ±5% 1/4W	10013-45	Ref
A15R16	A-3	Res., Car. Film 47KΩ ±5% 1/4W	10013-45	Ref
A15R17	B-5	Res., Car. Film 470Ω ±5% 1/4W	10013-21	Ref
A15R18	C-2	Res., Car. Film 680Ω ±5% 1/4W	10013-23	Ref
A15R19	B-4	Res., Car. Film 680Ω ±5% 1/4W	10013-23	Ref
A15R20	B-4	Res., Car. Film 680Ω ±5% 1/4W	10013-23	Ref
A15R21	A-6	Res., Car. Film 220KΩ ±5% 1/4W	10013-53	1
A15R22	A-4	Res., Car. Film 47KΩ ±5% 1/4W	10013-45	Ref
A15R23	A-4	Res., Car. Film 47KΩ ±5% 1/4W	10013-45	Ref
A15R24	A-6	Res., Car. Film 100KΩ ±5% 1/4W	10013-49	2
A15R25	D-4	Res., Car. Film 1KΩ ±5% 1/4W	10013-25	1
A15R26	C-7	Res., Car. Film 10KΩ ±5% 1/4W	10013-37	6
A15R27	B-7	Res., Car. Film 470KΩ ±5% 1/4W	10013-57	3
A15R28	B-7	Res., Car. Film 470KΩ ±5% 1/4W	10013-57	Ref
A15R29	B-9	Res., Metal Film 806Ω ±1% 1/8W	10015-154	1
A15R30	B-9	Res., Metal Film 1.33KΩ ±1% 1/8W	10015-75	1
A15R31	A-9	Res., Metal Film 1.24KΩ ±1% 1/8W	10015-77	1
A15R32	A-9	Res., Metal Film 3.01KΩ ±1% 1/8W	10015-110	1
A15R33	A-9	Res., Var. Comp. 500Ω ±20% 1/4W	10046-1	1
A15R34	A-7	Res., Metal Film 3.83KΩ ±1% 1/8W	10015-32	1
A15R35	A-3	Res., Wirewound 4.9588KΩ ±.01% 1/8W	11695-16	1
A15R36	A-2	Res., Wirewound 9.945KΩ ±.01% 1/8W	11695-17	1
A15R37	A-5	Res., Wirewound 19.935KΩ ±.01% 1/8W	11695-18	1
A15R38	A-4	Res., Metal Film 39.96KΩ ±0.1% 1/8W	12449-52	1
A15R39	A-1	Res., Metal Film 50.00KΩ ±0.1% 1/8W	12449-53	1
A15R40	A-2	Res., Metal Film 100.0KΩ ±0.1% 1/8W	12449-33	1
A15R41	A-3	Res., Metal Film 200KΩ ±1% 1/8W	10015-62	1
A15R42	A-4	Res., Metal Film 402KΩ ±1% 1/8W	10015-63	1
A15R43	A-1	Res., Metal Film 499KΩ ±1% 1/8W	10015-45	3
A15R44	A-1	Res., Metal Film 499KΩ ±1% 1/8W	10015-45	Ref
A15R45	A-2	Res., Metal Film 499KΩ ±1% 1/8W	10015-45	Ref
A15R46	A-3	Res., Car. Comp. 2MΩ ±5% 1/4W	10013-74	1
A15R47	A-4	Res., Car. Comp. 3.9MΩ ±5% 1/4W	10013-68	1
A15R48	D-8	Res., Car. Film 10KΩ ±5% 1/4W	10013-37	Ref
A15R49	A-8	Res., Metal Film 2.50KΩ ±1% 1/8W	12449-22	1
A15R50	B-7	Res., Metal Film 10.0KΩ ±1% 1/8W	10013-7	3
A15R51	A-8	Res., Metal Film 10.0KΩ ±1% 1/8W	10013-7	Ref
A15R52	A-7	Res., Metal Film 10.0KΩ ±1% 1/8W	10015-7	Ref
A15R53	B-7	Res., Metal Film 909Ω ±1% 1/8W	10015-71	Ref
A15R54	B-7	Res., Var. Comp. 50KΩ ±20% 1/4W	10046-3	2
A15R55	B-7	Res., Metal Film 49.9KΩ ±1% 1/8W	10015-133	1
A15R56	B-7	Res., Metal Film 196KΩ ±1% 1/8W	10015-240	1
A15R57	B-7	Res., Metal Film 9.09KΩ ±1% 1/8W	10015-12	1
A15R58	C-8	Res., Car. Film 3.3KΩ ±5% 1/4W	10013-31	1
A15R59	C-8	Res., Car. Film 4.7KΩ ±5% 1/4W	10013-33	Ref
A15R60	C-9	Res., Car. Film 10KΩ ±5% 1/4W	10013-37	Ref
A15R61	C-8	Res., Car. Film 10KΩ ±5% 1/4W	10013-37	Ref
A15R62	B-9	Res., Var. Comp. 50KΩ ±20% 1/4W	10046-3	Ref
A15R63	D-8	Res., Car. Film 33KΩ ±5% 1/4W	10013-43	1
A15R64	C-9	Res., Car. Film 22KΩ ±5% 1/4W	10013-41	1
A15R65	C-9	Res., Car. Film 470KΩ ±5% 1/4W	10013-57	Ref
A15R66	B-9	Res., Car. Film 22Ω ±5% 1/4W	10013-5	2

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PM PART NO.	TOT. QTY.
A15R67	B-8	Res., Car. Film 4.7KΩ ±5% 1/4W	10013-33	Ref
A15R68	B-9	Res., Car. Film 10KΩ ±5% 1/4W	10013-37	Ref
A15R69	B-9	Res., Car. Film 10KΩ ±5% 1/4W	10013-37	Ref
A15R70	B-9	Res., Car. Film 22KΩ ±5% 1/4W	10013-5	Ref
A15R71	B-8	Res., Car. Film 100KΩ ±5% 1/4W	10013-49	Ref
A15R72	C-7	Res., Car. Film 6.8KΩ ±5% 1/4W	10013-35	1
A15U1	A-8	IC LM324A	13471	1
A15U2	C-8	IC SN74LS51N	13470-35	1
A15U3	A-6	IC CA3039	11118	2
A15U4	A-5	IC CA3039	11118	Ref
A15U5	B-5	IC MCT-6	13476	7
A15U6	B-4	IC MCT-6	13476	Ref
A15U7	B-4	IC MCT-6	13476	Ref
A15U8	B-3	IC MCT-6	13476	Ref
A15U9	B-3	IC MCT-6	13476	Ref
A15U10	B-2	IC MCT-6	13476	Ref
A15U11	B-1	IC MCT-6	13476	Ref
A15U12	C-6	IC SN74LS27N	13470-9	1
A15U13	C-5	IC SN74LS74N	13470-13	1
A15U14	C-4	IC SN74LS174N	13470-33	2
A15U15	C-3	IC SN74LS42N	13470-12	1
A15U16	C-1	IC SN74LS174N	13470-33	Ref
A15U17	D-6	IC SN74LS00N	13470-1	2
A15U18	D-5	IC SN74LS20N	13470-32	1
A15U19	D-4	IC SN74LS04N	13470-4	2
A15U20	D-3	IC SN74LS00N	13470-1	Ref
A15U21	D-2	IC SN74LS04N	13470-4	Ref
		Socket IC, 14 Pin	10978-1	9
		Socket IC, 16 Pin	10978-2	6
		Socket IC, 8 Pin	10978-4	1
		TRIGGER CIRCUIT P.C. BOARD ASSEMBLY 13522		
A6R47		Met. Film 4.99KΩ ±1% 1/8W	10015-65	
		(Used on Trigger Circuit only with options 05 and 06)		

WAVETEK MICROWAVE, INC.

SUPPLEMENTARY DATA

TRIGGER DELAY DATA

This instrument is equipped with additional circuitry providing the user to select a trigger delay range of either 100 microseconds or 10 microseconds, with proportional resolution. It is particularly valuable if pulses of short duration are being measured. A front panel switch selects the desired range.

SPECIFICATIONS

Switch Position	x 1	x.1
Delay Range	0-100μ sec	0-10μ sec
Resolution, Approximate	0.1μ sec	.01μ sec
Linearity	±2μ sec	±1μ sec
Minimum Delay	<1μ sec	<0.35μ sec

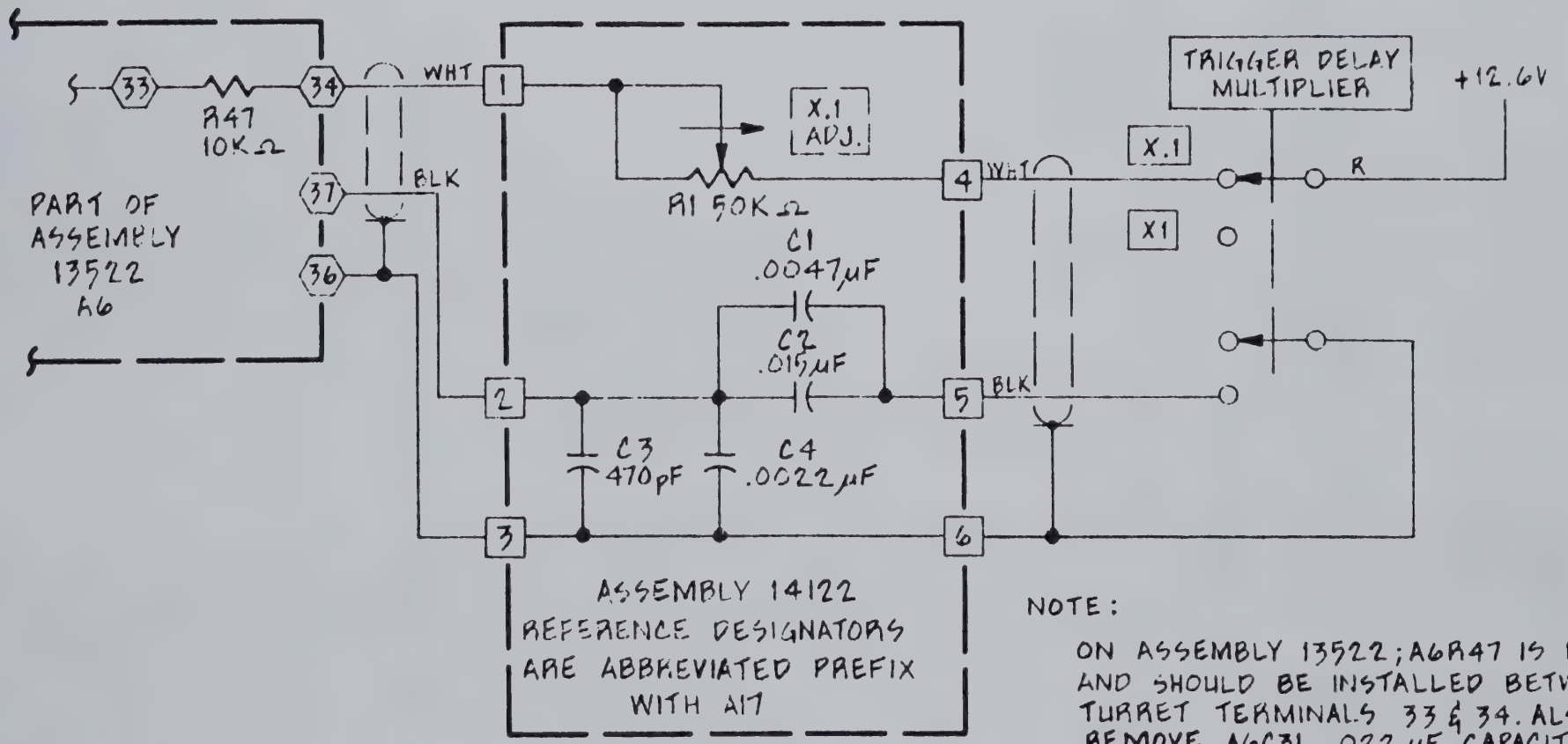
REPLACEABLE PARTS LIST

Circuit Reference	Part No.	Description
A6R47	10013-37	Carbon Film 10KΩ± 5% ¼W
A17C1	10007-3	Mylar .0047μF ±0% 200V
A17C2	10007-13	Mylar .015μF ±10% 200V
A17C3	10000-3	Ceramic 470 pF ±20% 1000V
A17C4	10007-2	Mylar .0022 μF ±10% 200V
A17R1	10046-3	Variable 50K Ω±20% ¼W

(See SD 14123 on the next page for Option 06 modifications)

14122

SYM	REVISION	ECO	DATE



NOTE:

ON ASSEMBLY 13522; A6R47 IS 10KΩ AND SHOULD BE INSTALLED BETWEEN TURRET TERMINALS 33 & 34. ALSO REMOVE A6C31 .022μF CAPACITOR.

ITEM	REQD	PART NO	DESCRIPTION

LIST OF MATERIAL

NEXT ASSY

FINISH OR TREATMENT

UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES

TOLERANCE
XX ± .015
XXX ± .005

SCALE

		DATE
DRAWN	J.S.	2-10-78
ENG		
PROD		

WAVETEK MICROWAVE, INC.

10μs & 100μs DELAY RANGE
(OPTION 06)

DRAWING NO. 14123

REV

SHEET OF

SECTION 4

PERFORMANCE CHECKS

4.1 PURPOSE

The checks given in this section are useful for incoming inspection or periodic evaluation of instrument performance. If the instrument fails to meet one or more of the performance criteria listed here, refer to Section 6 for information on making the necessary adjustments.

4.2 EQUIPMENT REQUIRED

The following equipment is required to make the performance checks:

a. RF sweep sources covering at least 4.5 to 8 GHz, and 8 to 18.0 GHz. Source should have 10 mW output and a source SWR of<1.2 up to 7 GHz,<1.25 to 12.4 GHz, and<1.30 to 18.0 GHz. If a source of higher power but poorer SWR is available, a suitable attenuator may be used to improve the SWR. Harmonics and spurious must be down 50 dB. If only harmonics are a problem, a low pass filter may by inserted between the generator and the attenuator. Two are required to cover each octave. The sweeper should be leveled by means of feedback obtained from a directional coupler.

b. A set of directional couplers covering 4.5 GHz to 18.0GHz with minimum directivity of 30 dB.

c. A precision power bridge and thermistor mount. The thermistor mount should have its calibration factor known to and uncertainty of < 1% at 100 MHz. The bridge should contribute less than 0.5% error to the measurement.

d. A set of high quality attenuators equipped with precision Type N connectors. The SWR of each attenuator should be 1.2 to a frequency of 4.5 GHz. The attenuators should have attenuation values of 3, 6, 10 and 20 dB. Calibration data should be obtained giving the attenuation of the attenuators individually and in tandem to produce attenuations of 13, 16, 23 and 26 dB. The calibration data should be accurate to at least 0.02 dB/10 dB.

e. A pulse generator with 10 nS minimum rise-time, capable of supplying a 1 V negative pulse into 50Ω. There should be a 1 V positive trigger available 1 µs ahead of the output pulse.

f. An electronic counter capable of time interval measurement with independent start and stop inputs with 100 nS resolution. It must respond to a stop command of 80 nS duration.

g. An oscilloscope with 50 mV/division sensitivity and a rise time of < 20 nS, and 200 µV sensitivity at reduced bandwidth.

4.3 CALIBRATOR

Since the calibrator is the primary reference for the instrument, the accuracy of its output is very important. For this reason, it is carefully adjusted before leaving the factory so that its output, as measured by the instrument agrees with a standard source maintained by Pacific Measurements. It may be checked only if a high accuracy power measurement bridge is available. Do not attempt to to adjust the calibrator using an ordinary bench type power meter.

a. Carefully set the bridge balance with the thermistor mount attached to the CALIBRATOR OUTPUT with the calibrator switched off.

b. Turn the calibrator to +10 dBm and measure the power applied to the thermistor. It should measure 10 mW ± 0.3 mW. Note that this represents a 3% possible deviation. This deviation is possible because of the 1.5% specification on the test equipment used to measure it. It if is desired to cause the calibrator output to agree with the measurement standard, it may be adjusted by means of the recessed screwdriver adjustment located on the rear panel of the instrument.

4.4 POWER LEVEL TRACKING AT 100 MHz.

The following test checks the linearity of the instrument.

a. Set the controls on the Model 1018B as follows:

PULSE AVERAGING	ON-MAX RESET
TRIGGER	FREE RUN
CAL FACTOR LEVER SWITCH	0
CALIBRATOR	+10 dBm
RANGE	+10 mW DIRECT
TRIGGER DELAY	any
CAL FACTOR - dB	any

b. Connect the detector to the CALIBRATOR OUTPUT and adjust the +10 dBm CAL control so that the display reads 10.00 mW. Set the CALIBRATOR switch to -20 dBm and set the -20 dBm CAL if required.

c. Check the tracking of the instrument using the values shown in Table 4-1. You will have to compute the correct value for the display for each attenuation by multiplying the value given under "READING" by the correction factor known from the attenuator calibration data. If the correction is given in dB, derive the corresponding linear equivalent by the following formula:

$$\text{LINEAR CORRECTION} = \text{ANTILOG}\ \frac{\text{CORRECTION IN dB}}{10} \qquad \text{(Eq. 4-1)}$$

For calibration correction values to 0.3 dB see Table 6-1. The table has blank spaces provided so that you can write in the corrected values for your attenuators, either in the manual or in a photocopy of the table. Under "DEVIATION PERMITTED", there are three points where resetting the +10 dBm CAL adjustment is called for. There is, of course, no correction to the reading at +10 dBm, as no attenuator is used there. The other two points must be set to the corrected value. The deviations listed for the 100 µW range make allowance for noise.

4.5 CAL FACTOR CORRECTION ACCURACY.

The following test checks the accuracy of the CAL FACTOR control.

a. Set the controls as in 4.4a except use 10mW range. Connect the detector to the CALIBRATOR OUTPUT and set the +10 dBm CAL adjustment so that the display reads 10.00 mW.

b. Turn the CAL FACTOR lever switch to - and successively turn the CAL FACTOR - dB rotary switch from .05 through each position, ending at 1.0. At each step compare the display reading with the values in Table 4-2. Repeat with the lever switch set to +. The values read from the display should agree with those from the tabie within 5 digits.

4.6 INPUT CIRCUIT RISE-TIME

The following test determines the rise-time of the instrument.

Set the pulse generator to give a negative pulse of 0.5V amplitude when terminated in 50Ω. The duration of the pulse should be approximately 5µs. DO NOT EXCEED 1V AMPLITUDE. Set the repetition rate to 500Hz. Set the delay between the trigger pulse and the output pulse to be approximately 1µs. Connect the trigger pulse to the TRIGGER INPUT of the Model 1018B. Connect the detector to the output pulse thru a 10 dB pad.

Set the controls on the Model 1018B as follows:

Pulse Averaging	On-Max Reset
Trigger	Ext.
Cal Factor Lever Switch	0
Calibrator	OFF
Range	1mW
Trigger Delay	2µs
Cal Factor-dB	Not Applicable

TABLE 4-1

RANGE	ATTENUATION (dB)	READING	CORRECTED READING	DEVIATION PERMITTED (±)
10 mW	0	10.00	10.00	.01 (Set)
10 mW	3	5.01		.16
10 mW	6	2.51		.09
10 mW	10	1.00		.04
1 mW	10	1.000		.001 (Set corr. reading)
1 mW	13	.501		.016
1 mW	16	.251		.009
1 mW	20	.100		.004
100 µW	20	100.0		.1 (Set corr. reading)
100 µW	23	50.1		1.8
100 µW	26	25.1		1.0
100 µW	30	10.0		0.6

TABLE 4-2

CAL FACTOR SETTING (dB)	DISPLAY READING (-)	(+)
.05	10.12	9.89
.1	10.23	9.77
.15	10.35	9.66
.2	10.47	9.55
.25	10.60	9.44
.3	10.72	9.33
.35	10.84	9.22
.4	10.96	9.12
.45	11.09	9.02
.5	11.22	8.91
.55	11.35	8.81
.6	11.48	8.71
.65	11.61	8.61
.7	11.75	8.51
.75	11.88	8.41
.8	12.02	8.32
.85	12.16	8.22
.9	12.30	8.13
.95	12.45	8.04
1.0	12.59	7.94

a. Connect the oscilloscope to the MONITOR OUTPUT and adjust it to display the 5 μS pulse that will be present there. Adjust the TRIGGER LEVEL controls to give 0.5 V as read from the oscilloscope. Set the oscilloscope to 0.1 V/division and read the time required for the pulse to cover the 4 divisions from 0.5 division (10%) up from the bottom to 0.5 division (90%) down from the top of the pulse. This is the rise-time of the monitor; it should be less than 0.1 μS.

4.7 CALIBRATION OF THE DELAY DIAL

The following procedure checks the calibration of the DELAY dial.

a. Set the TRIGGER control to EXT. Connect the output from the pulse generator to the TRIGGER INPUT and with a tee connector to the start input of the counter. Connect the rear panel REFERENCE output to the stop input of the counter. Set the pulse generator to supply a 1 μS, 2V positive pulse. It should be set in a single pulse mode.

b. Set the dial on the DELAY control to 0 (minimum) delay. Trigger the pulse generator and note the reading on the counter. Repeat the procedure with the dial set to 10 μS, 20 μS, etc., to 100 μS. Subtract the reading at zero from the subsequent readings. The result should be correct, within ± 2 μS.

SECTION 5

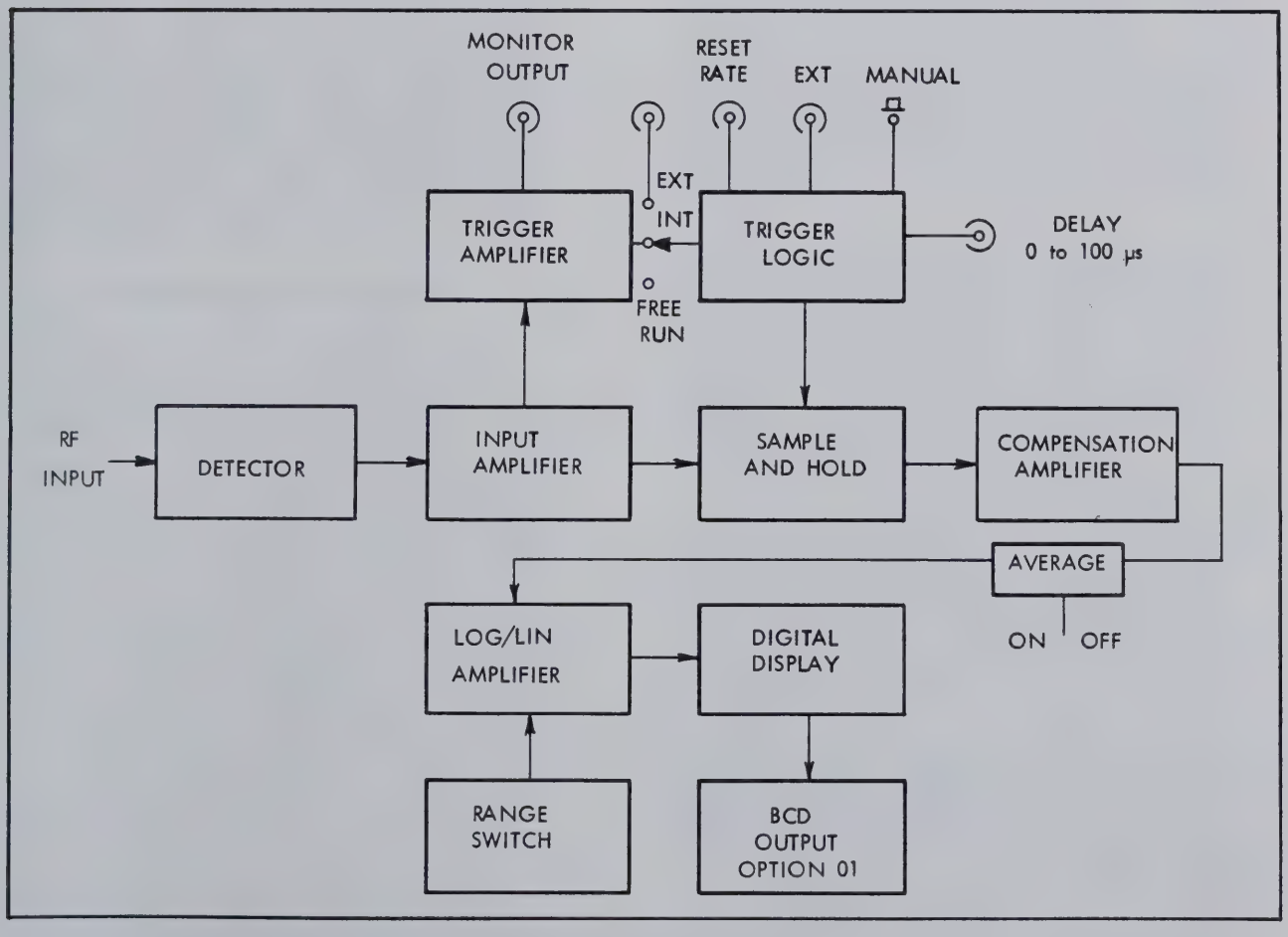
CIRCUIT DESCRIPTION

5.1 GENERAL

A simplified block diagram of the Model 1018 B is shown in Figure 5-1. The RF signals applied are to the detector. The output of the detector is amplified in a low noise, wide band amplifier. A trigger amplifier monitors the output of the input amplifier and feeds the trigger circuits. In addition, the output of the trigger amplifier drives the monitor output jack so that the detected video pulse may be observed with an oscilloscope. The trigger logic is actuated by the output of the trigger amplifier when the trigger selector switch is in the INTERNAL position. When the trigger selected switch is set to EXTERNAL, an external 1 volt pulse is required to actuate the trigger logic. In the FREE RUN position, the trigger logic is actuated immediately following the completion of one measurement cycle, so that the instrument takes readings at the most rapid possible rate.

The trigger logic includes a delay circuit which permits a manual adjustment of the period between the arrival of the trigger and the point at which a pulse is sent to the sample-and-hold circuit. The trigger circuit will be reset so that it will accept additional triggers after a period of time controlled by the RESET RATE control. If the RESET RATE control is turned counterclockwise to the EXT position the trigger logic can be reset by either an external pulse or a manual pushbutton.

After the trigger delay has occurred, a pulse is applied to the sample-and-hold circuit causing it to retain the data at the output of the input amplifier at that instant. The sample-and-hold circuit feeds a compensation amplifier which corrects for the crystal detector characteristics and generates a voltage proportional to input power over the entire dynamic range of the system. In order to obtain the correct scale factor for



SIMPLIFIED BLOCK DIAGRAM
FIGURE 5-1

each display range, the signal from the compensation amplifier is amplified either logarithmically or linearly, depending upon the function selected, and applied to the digital display. The digital display converts the analog information at its input into binary coded decimal digital form. This data is then decoded for display by the display tube drivers and also is supplied to the BCD interface circuit for output as a BCD signal to data acquisition equipment.

5.2 BLOCK DESCRIPTIONS

5.2.1 INPUT AMPLIFIER

The input amplifier of the Model 1018 B is an operational amplifier with field effect transistor input. Its gain is adjustable to compensate for different detector sensitivity. Its dc input is stabilized by means of a separate chopper amplifier which monitors the input summing junction voltage and feeds a corrective signal back to its positive input. The chopper amplifier uses field effect transistors as chopper switches operating at a 600 Hz carrier frequency. The field effect transistors avoid the service problems of earlier electromagnetic choppers and permit higher frequency operation which avoids the l/F noise associated with lower frequency operation.

5.2.2 TRIGGER CIRCUIT

Refer to the circuit diagram, Drawing Number 13523. A trigger is defined as a positive transition at pin 6 of U3. Recognize that U3 is a pair of 4 input nand gates wired to form an R-S flip-flop. Assume that U3 has been reset to begin with. A trigger will be generated if any one of the 3 externally connected inputs to U3 is driven negative. This will happen if a trigger is supplied externally through T3 and Q6 or if a trigger comes from the internal trigger amplifier Ul and the trigger comparator U2. Only one of these two paths is enabled, however, as the trigger selector switch disables one path or the other. The third input is used to cause a trigger to occur after 5 seconds if no proper trigger has arrived, so that the display will not retain a reading indefinitely, leading to possible operator confusion.

The arrival of a trigger starts a timing sequence allowing the analog circuits sufficient time to react before the display responds. Immediately after the arrival of a trigger, the 500 µS delay (U4) and the 0 to 100 µS variable delay (Q15 to Q20) start their timing cycles. At the end of the variable delay a trigger is generated to drive the sampling circuit. At the end of the 500µS delay a 1 mS pulse is generated (U5) to drive the final hold gate and the reset delay is started. At the end of the 1 mS period, a trigger initiates the read cycle of the digital display and enables the reset trigger generator (U8).

Depending upon the setting of the RESET knob, the reset delay circuit will generate a reset pulse to the trigger flip-flop immediately after it is enabled, or a time later, as controlled by the knob, or not at all (when the knob is set to EXT). In the external mode, a reset trigger must be supplied by pushing the RESET button or by a 1 V pulse supplied to the RESET INPUT jack. In any of the above cases, a negative pulse will be supplied to one of the reset inputs of the trigger flip-flop.

Five seconds after the end of the 500 µS pulse, the delay circuit comprising Q2, Q3, and Q4 generates a trigger which is fed back to the trigger flip-flop, initiating a read cycle. If there is no input to the detector the display will thereupon read zero.

In the average mode it is desirable to trigger the display only about 5 times per second, as the eye then can assimilate the information more readily. This is accomplished by the trigger generator (U6) which, after generating a trigger, is insensitive to further inputs for 200 mS.

5.2.3 SAMPLE-AND-HOLD CIRCUIT

The high speed sampler gate is driven by a pulse-forming circuit triggered from the trigger logic as indicated above. The sampler gate is open for approximately 80 ns, allowing sufficient time for the primary sample-and-hold capacitor to charge completely to the input amplifier's output voltage. An isolation amplifier with field effect transistor input monitors the voltage on the primary sampling capacitor and feeds it to the data-hold gate consisting of a field effect transistor and a large capacitor. The gate of the field effect transistor is driven from a 10 µS pulse-forming circuit. The data hold capacitor is quite large and stores its voltage for a time sufficient for the digital display to take a reading.

5.2.4 COMPENSATION AMPLIFIER

Crystal diode detectors have been used to measure RF power for quite some time, but until recently their useful measurement range has been restricted to the square law region where output voltage is approximately proportional to input power. In reasonably fast-response applications, the lower end of the measurement range is limited by noise and is about -20 dBm. The upper end of the usual measurement range occurs at about -10 dBm where the detector output response begins to depart significantly from square law. In the Model 1018B compensation for the crystal characteristic is obtained by using a diode shaping network in the feedback of the compensation amplifier. The result is that the output of the compensation amplifier is proportional to RF power to levels up to +10 dBm. This is possible because of the predictable behavior of the diodes used in crystal detectors.

Figure 5-2 shows the schematic of a typical crystal detector. The crystal diode, CR1, merely rectifies the RF voltage across the terminating resistor, R_t. In the Model 1018B R_t is a 50 ohm termination and

CR1 is a microwave point contact diode. The relationship between the peak RF input voltage, E, and the dc output of the detector, E_{dc}, is described by the following equation:

$$\left[1 + \left(\frac{R_V}{R_L}\right) E_{dc}\right] e^{\alpha E_{dc}} = I_o(\alpha E) \qquad \text{Equation 1.}$$

Where: R_V is the diode low level video resistance

R_L is the detector load resistance

α is proportional to Q/kt

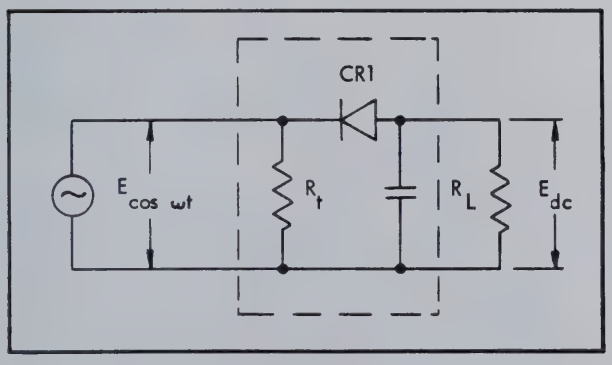
I_o is the zero order modified Bessel function of the first kind.

Below -20 dBm, Equation (1) may be approximated by the expression:

$$E_{dc} = \frac{\alpha E^2}{4(1+k)} \qquad \text{Equation 2.}$$

Where: k is R_V/R_L

The square law relationship shown in Equation 2 shows that the detector dc output is proportional to the RF input voltage which in turn is proportional to the RF input power. Equation 2 describes the desired detector response while Equation 1 describes the actual detector response.



DETECTOR
FIGURE 5-2

The compensation circuitry in the Model 1018B provides very little correction for low input levels; as the input level is increased, successive shunt diodes are engaged in the shaping network of the compensation amplifier increasing its gain to compensate for the departure from square law of the RF detector.

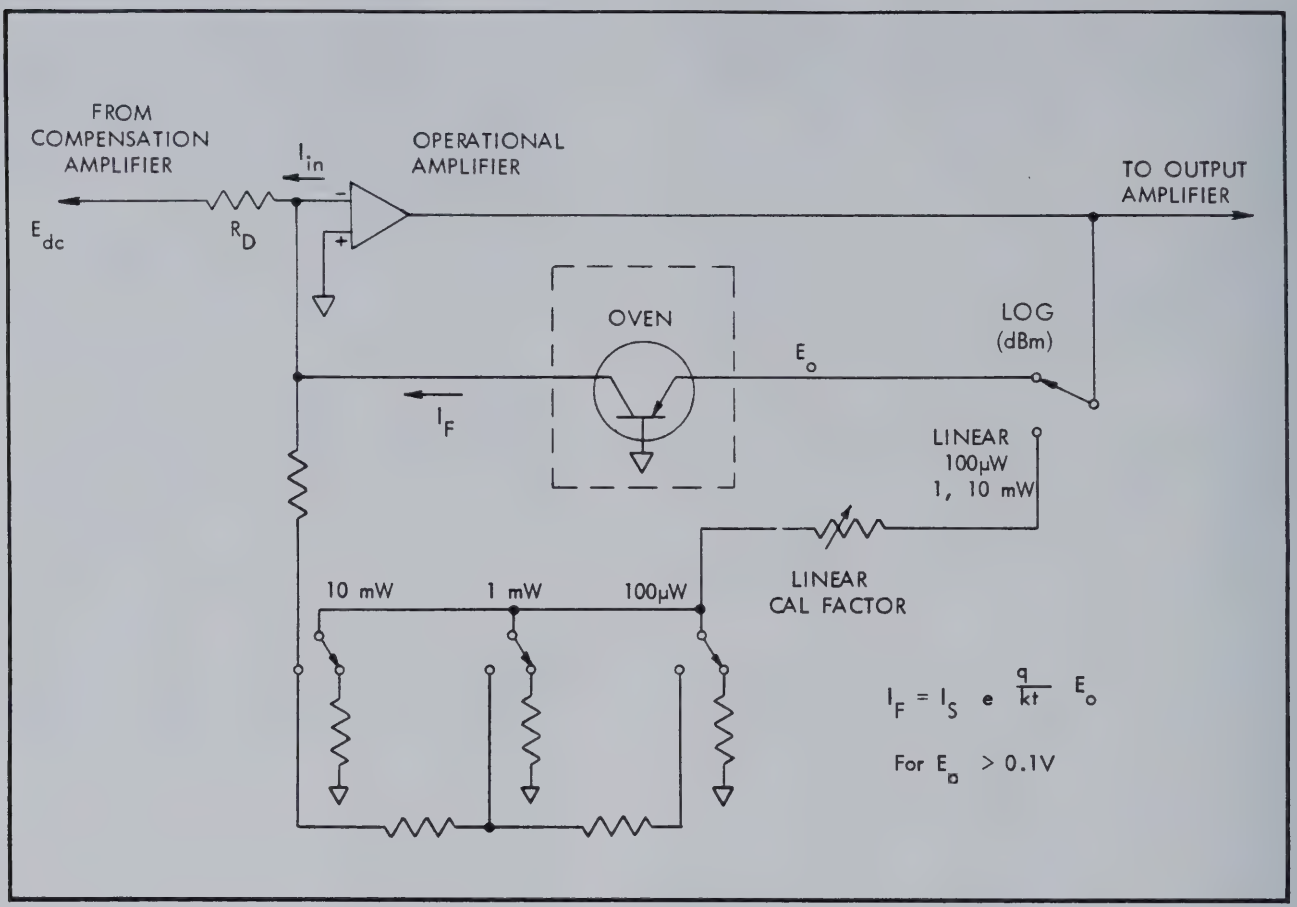
5.2.5 LOG/LIN AMPLIFIER

A simplified circuit diagram of the Log/Lin Amplifier is shown in Figure 5-3. This amplifier consists of a high gain, operational amplifier capable of being operated in logarithmic or linear mode by selection of its feedback network.

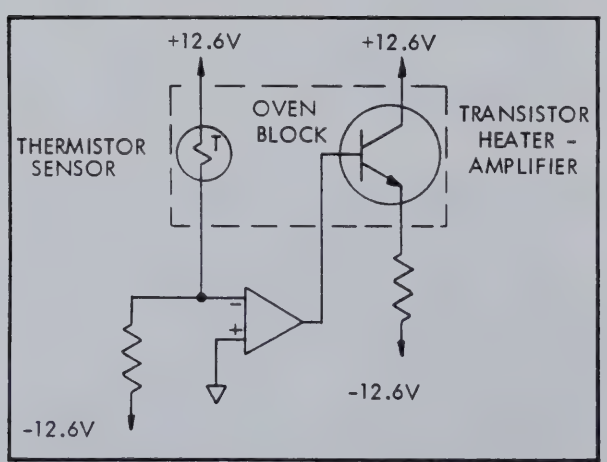
To operate the Log/Lin amplifier in the logarithmic mode, a transistor is used in the feedback loop around the operational amplifier. Referring to Figure 5-3, I_{in} is proportional to $e^{qE_o/kt}$ since the operational amplifier has very high gain. Thus, E_o is proportional to log I_{in}. This logarithmic relationship between I_{in} and E_o holds over many decades of current because parasitic collector currents in the logging transistor are eliminated by operating its collector base junction at zero volts. When operated in the logarithmic mode, the output level of this amplifier is approximately 6.4 mV/dB and is a function of the temperature of the logging transistor. To maintain the logarithmic coefficient independent of ambient temperature, the logging transistor is mounted in a temperature controlled oven and held at 50°C. The oven control circuit which maintains the oven at a constant temperature is shown schematically in Figure 5-4. A power transistor serves to heat the oven and a thermistor mounted in the oven senses temperature. A simple one-stage amplifier is connected between the thermistor and the transistor heater amplifier. When the oven is at its correct temperature, the driver amplifier input is very near zero volts and the transistor heater amplifier generates just enough heat to maintain the oven at its proper temperature.

In the linear mode the operational amplifier is controlled by a resistive feedback attenuator. In the linear mode the log/lin amplifier has three gain settings which correspond to 100 μW, 1 mW and 10 mW full scale. In addition, in the linear mode the amount of feedback is also controlled by the calibration factor switch which cascades a second attenuator in series with the range switching attenuator. The range switching attenuator presents a constant impedance to the calibration factor attenuator so that the effect of the calibration factor attenuator is independent of the particular range the instrument is set to. In the log mode another section of the calibration factor switch supplies offsetting current to the input of the operational amplifier monitoring the voltage of the logging transistor.

A separate amplifier is required to monitor the log transistor voltage in order to raise the signal level to the value required so that the digital display will read correctly. This amplifier is of the operational type, so that a current may be summed in corresponding to the fixed 50Ω reference level for dBm and the arbitrary reference level for dB. The output of the log/lin amplifier then feeds the digital display.



LOG/LIN AMPLIFIER
FIGURE 5-3



OVEN CONTROLLER
FIGURE 5-4

5.2.6 CALIBRATOR

In Section 7, Drawing Number 13670, is a circuit diagram of the RF calibrator. The calibrator consists of a 105 MHz oscillator and a 30 dB, 50 ohm attenuator. CALIBRATOR OUTPUT is from a front panel Type N Connector.

The 105 MHz oscillator-amplifier is operated within a very stable amplitude regulating loop so that its output is only a function of a reference voltage. The calibrator output level is set by adjusting the reference voltage divider. The amplifier output is fed to the calibrator switch from a 50 ohm attenuator tapped into the 105 MHz resonant circuit. In the first position, the calibrator switch de-energizes the calibrator. In the second position, the calibrator is energized and connected to the calibrator output through a 30 dB, 50 ohm attenuator. Finally, in the third position, the calibrator oscillator is energized and connected directly to the calibrator output to give +10 dBm (10 mW) output.

5.2.7 DIGITAL DISPLAY

The digital display is used to convert the analog signal developed by the instrument into digital form for read-out using 7 segment LED's. In addition, it generates a Binary Coded Decimal (BCD) signal, which can be used with data acquisition systems or the IEEE Standard Digital Interface for Programmable Instrumentation. In this instrument, the analog to digital (A to D) process is performed by a successive approximation method for high speed operation. For display purpose, the internal analog voltage is scaled down by a factor of four, so that a decimal output of 1000 corresponds to an input of 4.000 volts.

For descriptive purposes, the digital display unit can be broken down into five functional elements.

The "Absolute Value Circuit" which converts signals of either polarity into a negative voltage signal and a sign bit signal. It also isolates the rest of the instrument from noise generated in the digitizing process.

The "Reference Voltage Supply" which provides a stable standard of reference for comparison with the input analog signal in the A to D circuit. It also provides the necessary off-set voltage so the diode switches in the approximation circuit can be turned on and off by TTL level signals.

The "Approximation Circuit", which successively increments the current through the precision resistor network until it balances the current supplied by the input signal through the absolute value circuit.

The "Comparator", which generates a control signal for the Approximation Circuit.

The "Logic Control Circuit" which provides the control information to enable an orderly and sequential conversion process.

In the Pacific Measurements' Digital Display, the process of approximation is carried out in a BCD sequence, starting from the most significant digit. The information is retained in three BCD counters and a "D" type flip-flop. At the start of each conversion process, the bit "10" register and the decimal counters are set to 0999. The bit "10" register state is determined first and the decimal counter units' (DCU's) states are determined successively from the most significant digit to the least significant. The final answer in the digital display has an accuracy of ± 1/2 LSB (least significant bit). For each decade, the numbers from zero to nine are formed as an appropriate combination of binary weighted numbers 1, 2, 4, and 8.

In order to form the 3 1/2 digit display, a total of thirteen BCD bits is required. The approximation circuit consists of 13 precision resistors connected to 13 diode switches. The other end of each diode is tied to a common point leading to the comparator input. If a switch is activated, it will supply a precise amount of current corresponding to its bit position. Each switching diode is controlled by the digital output of the BCD counters and a bit "10" register. Whenever the current supplied by the resistor network is less than the current required by the input signal, the comparator output will be high and the currently active BCD counter will be incremented, which will then actuate the corresponding switches for additional current through the resistor network. Vice-versa, when the current through the resistor network is greater than the current required by the input signal, the comparator output will be low, and the incrementing BCD counter will stop counting and retain the correct digital information.

ABSOLUTE VALUE CIRCUIT

Refer to the circuit diagram 13343, Sheet 1 in Section 7. Since the approximation process operates in one direction only, the input signals of both polarities have to be reconditioned to one polarity only. If a positive voltage is applied to the input of the digital display U13A becomes a voltage follower and it applies a positive voltage to R12. Transistor Q2 is turned on so U6B can set the "+" signal line high. Conversely, if a negative voltage is applied, diode CR2 will not conduct. The output of U13C becomes positive and it supplies the current through diode CR4 to R12 and R11. Transistor Q2 is turned off so U6B can set the "-" signal line high. The differential ampifier U13B inverts the input signal, so the voltage applied to R23 is always negative.

REFERENCE VOLTAGE SUPPLY

The Reference Voltage Supply is formed by a temperature stable Zener diode (CR5) and a resistive network consisting of R15, R27, and R40. U13D uses the voltage across the Zener diode to obtain the reference for the approximation circuit and C12 stabilizes this reference voltage. The diode in the feedback path of U13D compensates for any temperature variation of current through the precision resistor R44. Because the Op Amp cannot supply enough current through the resistor network, additional current is provided by current through R13. The Zener diode and the comparator are referenced off-ground so that TTL level voltages can switch the diodes in the approximation circuit. In order to insure long term stability, the Zener diode is aged for several days prior to installation. If a replacement Zener in installed, the + Bal pot R39 and + F.S. pot R41 may have to be readjusted after a few days of operation because during the first few hours of operation, there may be appreciable voltage change across the Zener diode. Further voltage changes are slight and occur at a very slow rate.

APPROXIMATION CIRCUIT

The approximation circuit consists of an array of

precision resistors and diodes in combination, operated as current switches drive from the decimal counters bit "10" register. When a bit is high, a fixed amount of current will flow to the comparator through the corresponding current switch; vice-versa, when it is low, the current will flow to the output of the TTL IC. Very precise resistors and well-matched diode arrays are used in the most significant bits to insure the accuracy of A to D conversion.

COMPARATOR

A fast comparator U14 monitors the summing of the approximation circuit. Since the input analog is always negative at R23 and the feedback signal from the approximation circuit is always positive, the comparator will have a negative output voltage if the current supplied by the approximation circuit is greater than the input current, and a positive output voltage if the current supplied by the approximation circuit is less than the input current. The output of the comparator is latched by U8B after it has had time to settle; in this way the effect of comparator noise is minimized.

LOGIC CONTROL CIRCUIT

The main function of the logic circuitry is to perform a commutation process. In order for the process of successive approximation to proceed in an orderly fashion, it is necessary to generate control signals which successively let through the incremental current from the approximation circuit, starting with the most significant digit and continuing down through the least significant. U4A and U4B, together with R1, C1, C2, and Q1 form the clocking circuit for the system. The clock cycle is approximately 8 µs long. U1 and U2 form a four decade state-counter and U3 forms the state decoder. U6A, U10, and U11 are the decimal counter units (DCU's) and U6A is the most significant bit "10" register. In this instrument, the over-range signal at the pin 5 of U6A becomes high if the display is greater than or equal to 1100. U6B stores the polarity signal from the absolute value circuit.

When a positive trigger pulse is received by U8A, it resets the state counter to zero, enables the clock, and sets the digital register to 0999. At the 8th clock pulse, the polarity signal is latched and the bit "10" register stores the latched output of the comparator. At the 9th clock pulse, the most significant DCU will be reset to 0. From count 10 to count 8, the most significant digit will be determined by incrementing the DCU at each clock pulse until the comparator output becomes low. This will disable the clock until it is started again by a new trigger pulse. The display will be blanked during the conversion period (approximately 320 µs), to eliminate flicker. The decimal point and the annunciator are determined by the range-switching buttons in the front panel and a lamp test switch button is provided at the back panel to test the LED's.

SECTION 6

MAINTENANCE

6.1 PERIODIC MAINTENANCE

The following maintenance should be performed once a year unless the instrument is operated in an extremely dirty or chemically contaminated environment or is subjected to severe abuse. In such cases, more frequent maintenace is indicated.

a. Blow out all accumulated dust with forced air under moderate pressure.

b. Inspect the instrument for loose wires and damaged components. Check to see that all plug-in PC boards are properly seated in their sockets and that all wire lead connectors are properly seated on their PC board pins.

c. Make a performance check in accordance with the procedure of Section 4. If the performance is within specifications no further service is indicated.

6.2 INTERNAL ADJUSTMENTS AND TEST POINTS

The following is a list of adjustments and test points supplied for ready reference. Do not attempt to make any adjustments until you have carefully read the material in Section 6.3.

6.2.1 DESCRIPTION OF ADJUSTMENTS

The function of each adjustment is described below.

a. A1R9 +12.6 V POWER SUPPLY CALIBRATION ADJUSTMENT. Used to set the positive power supply to +12.6 V within ± 10 mV.

b. A1R18, -12.6 V POWER SUPPLY CALIBRATION ADJUSTMENT. Used to set the negative power supply to -12.6 V within + 10 mV.

c. A2R32, AVERAGING CIRCUIT BALANCE. Used to set the voltage at A2J3 to zero with A2J1 shorted to A2J2.

d. A4R7, LOG/LIN AMPLIFIER BALANCE ADJUSTMENT. Used to adjust the voltage at A4J1, to zero V ± 1 mV.

e. A4R9, LOG CALIBRATION FACTOR ADJUSTMENT. Used to set the log calibration factor so that the digital display changes by exactly 1 dB as the calibration factor control is turned from 0 to + 1 dB.

f. A4R12, 40 mV/dB ADJUSTMENT. Used to set the voltage at A4J4 so that it changes 400 mV ± 4 mV for each 10 dB changes in input signal level.

g. A4R17, dBm CALIBRATION ADJUSTMENT. Used to set the digital display to read 10.0 dBm for 10 mW input to the detector.

h. A4R38, dB OVERRANGE ADJUSTMENT. Used to set the overrange indicator to light with 11 mW supplied to the detector.

i. A4R44, SAMPLER NEUTRALIZING. Compensates for the drain/source capacity of A4Q9.

j. A4R60, COARSE BALANCE ADJUSTMENT. Used to adjust the isolation amplifier between the high speed sampler and the data hold circuit so that with no RF input to the detector 0 V is obtained at A4J7.

k. A4R86, COMPENSATION AMPLIFIER BALANCE ADJUSTMENT. Used to adjust the balance of the compensation amplifier so that with no RF input to the detector, 0V is measured at A4J10.

l. A4R98, CALIBRATION CENTERING ADJUSTMENT. Used to bring the +10 dBm CAL control on the front panel to the center of its range.

m. A4R101, COMPENSATION AMPLIFIER GAIN ADJUSTMENT. Used to adjust the gain of the compensation amplifier so that the degree of compensation required for the characteristics of detector diode used will fall within the adjustment range of the shaping network.

n. A4R104 through A4R128, DIODE LAW COMPENSATION ADJUSTMENTS. These adjustments are used to set the tracking of the instrument from -20 through +10 dBm.

o. A4R160, INPUT ZERO ADJUSTMENT. Used to set the preamplifier output, A4J6 to 0 V with no RF input to the detector.

p. A5R9, dB OFFSET. Used to set the dB offset to add 20.0 dB to the dB reading when the 20 dB COUPLER button is pushed.

q. A6R69, DELAY CALIBRATION ADJUSTMENT. Used to set the sampling pulse delay to be 100 µs with the TRIGGER DELAY knob set to 99.99.

r. A6R78, DELAY ZERO ADJUSTMENT. Used to adjust the delay circuit for proper operation when the TRIGGER DELAY control is set to 0.00.

s. A7R21, -FULL-SCALE ADJUST. Used to adjust the display to read correctly for a negative input of 7 V.

t. A7R38. -BALANCE ADJUST. Used to adjust the display to read correctly for a negative input of 40 mV.

u. A7R39, +BALANCE ADJUST. Used to adjust the display to read correctly for a positive input of 10 mV.

v. A7R41, +FULL-SCALE ADJUST. Used to adjust the display to read correctly for a positive input of 7 V.

w. A7R84, 1.000 ADJUST. Used to adjust the display to read correctly between .999, 1.000 and 1.001.

x. A8C7, CALIBRATOR FREQUENCY. Used to adjust the calibrator frequency to be 105 MHz ± 1 MHz.

y. A8R19, -20 dBm ADJUST. Used to set the difference between the output at +10 dBm and the output at -20 dBm to be 30 dB± 0.05 dB.

z. A9R21, PREAMPLIFIER RESPONSE ADJUSTMENT. Used to adjust the preamplifier for proper pulse response.

aa. A9R22, PREAMPLIFIER GAIN ADJUSTMENT. Used to adjust the reamplifier to give 4 V output for 10 mW RF input to the detector. Measure at A4J6.

6.2.2 DESCRIPTION OF TEST POINTS

a. A1J1, +12.6 V. Measure between A1J1 and common , A1J2. The dc voltage should be +12.6 V ± 10 mV.

b. A1J2, COMMON LINE.

c. A1J3, -12.6 V. Measure between A1J3 and common, A1J2. The dc voltage should be -12.6 V ± 10 mV.

d. A2J1, AVERAGING CIRCUIT INPUT. May be shorted to A2J2 for setting A2R32.

e. A2J2, AVERAGING CIRCUIT COMMON.

f. A2J3, AVERAGING CIRCUIT OUTPUT. Measure between A2J3 and A2J2; set A2R32 to obtain 0 V ± 1 mV.

g. A4J1, LOG/LIN AMPLIFIER SUMMING JUNCTION. Measure between TP41 and TP43 and set A4R7 for 0 V ± mV.

h. A4J2, LOG POST AMPLIFIER OUTPUT. Measure between A4J2 and A4J3 and adjust A4R12 for 40 mV ± 0.4 mV/dB.

i. A4J3, INPUT CIRCUIT COMMON.

j. A4J4, LOG TRANSISTOR VOLTAGE. Used to check the operation of the logging circuit.

k. A4J5, OVEN CURRENT MONITOR. Measure between A4J5 and A1J3. Voltage should be approximately 2 V immediately after turn-on and settle to less than 0.6 V within five minutes.

l. A4J6, PREAMPLIFIER OUTPUT. Used to check the output level and the pulse response of the preamplifier.

m. A4J7, SAMPLE-HOLD ISOLATION AMPLIFIER OUTPUT. Measure between A4J7 and A4J3; adjust A4R60 to obtain 0 V ± 1 mV.

n. A4J8, COMPENSATION AMPLIFIER OUTPUT. Measure between A4J10 and A4J3; adjust A4R86 for 0 V ± 1 mV.

o. A4J9, CHOPPER DEMODULATOR OUTPUT. Measure between A4J9 and A4J3, using an oscilloscope. At the time the demodulator switch is closed, the voltage waveform should be 0 V. When demodulator switch is open noise should be present, magnitude of approximately 0.05 V P -P.

p. A4J10, SAMPLING PULSE. Measure between A4J10 and A4J3. Pulse is 80 ns going from -12 V to +5 V.

q. A4J11, HOLD-CIRCUIT DRIVE PULSE. Measure between A4J11 and A4J3. Pulse is 10 µS long, going from -12 V to +5 V.

r. A4J12, FIRST SAMPLE/HOLD OUTPUT. Measure between A4J12 and A4J3, used to adjust A4R44 for minimum capacitive feed thru of input pulse.

s. A6J1, +5 VOLT LOGIC SUPPLY. Measure between A6J1 and A6J2. Supply should be +5 V ± 0.25 V.

t. A6J2, TRIGGER CIRCUIT COMMON.

u. A7J1, +5 LOGIC SUPPLY. Measure between A7J1 and A7J5, +5 V ± 0.25 V.

v. A7J2, "NEW DATA" LINE. Measure between A7J2 and A7J5. A positive logic pulse appears here during the conversion period for the display. The width is approximately 320 µS. This pulse is useful for triggering an oscilloscope used to trouble-shoot the display.

w. A7J3, NEGATIVE UNIPOLAR INPUT VOLTAGE. Measure between A7J3 and A7J4. The voltage should be equal in magnitude to the voltage applied to the display but always negative.

x. A7J4, +1.25 V REFERENCE. Reference voltage for analog signals in the digital to analog converter.

y. A7J5, LOGIC COMMON. Reference point for logic voltages.

z. A8J1, CALIBRATOR CONTROL AMPLIFIER OUTPUT. Measure between A8J1 and COMMON, A1J2. If the voltage is between + and - 8 V, the circuit will be at a normal level for controlling the oscillator's amplitude.

6.3 CALIBRATION

6.3.1 EQUIPMENT REQUIRED FOR CALIBRATION.

a. A 4 digit +50% overrange Digital Voltmeter with 100 µV per digit minimum resolution on its most sensitive range.

b. A sensitive dc Voltmeter with at least 10 µV minimum resolution. An instrument with a full-scale range of 1 mV and a 5" scale will be adequate if the zero stability is good enough to permit measurements within 1 minor division of zero.

c. A precision power supply with at least 5 digit resolution. Maximum voltage 10 V. Accuracy 0.01%.

d. A precision power bridge and thermistor mount. The thermistor mount must have its calibration factor known to within 1% at 100 MHz. The bridge must contribute less than 0.5% error to the measurement at 10 mW.

e. A precisely calibrated step attenuator with excellent repeatability of attenuation, or a set of fixed attenuators. The calibration data should be accurate to 0.02 dB, over 30 dB range. If separate attenuators are used, the calibration data should be accurate to 0.02 dB for each unit individually and in combination with the others over the range from 0 dB to 30 dB in 1 dB increments.

f. A frequency Counter/Time Interval Meter with counting capability to 125 MHz. The time interval function must have separate start and stop inputs and a minimum resolution of 100 ns.

g. A Pulse Generator capable of supplying a 0.5 µs pulse with a repetition rate of 500 Hz. Amplitude capability to 2V into 50Ω. Maximum rise-time of 10 ns.

h. An oscilloscope with 10 ns maximum rise-time and 10 mV vertical sensitivity. An accessory X10 probe with less than 10 pF loading capacity is required.

6.3.2 CALIBRATION PROCEDURE

The Model 1018B employs solid state components exclusively. These are extremely reliable and generate little heat; consequently, there is little drift due to component aging, and adjustments to the instrument are rarely required. We therefore strongly recommend that if measurements indicate that an adjustment is set within the stated range that you do not attempt to put it "right on". It is often the case that variations in the equipment used to test the instrument account for small differences in measured values. Other adjustments that depend upon a given adjustment will be effected if it is reset. In short, BE ABSOLUTELY SURE THAN AN ADJUSTMENT IS REALLY REQUIRED BEFORE MAKING IT.

If a component is replaced, depending upon where in the circuit it is located, only certain of the calibration steps need be performed. In general, only those steps shown in the section pertaining to the specific circuit repaired need be carried out.

6.3.2.1 POWER SUPPLIES

a. Connect the digital voltmeter between A1J3 and A1J2. Adjust A1R18 to obtain -12.6 V ±10 mV.

b. Remove the voltmeter probe from A1J3 and move it to A1J1. Adjust A1R9 to obtain +12.6 V ±10 mV.

6.3.2.2 DIGITAL DISPLAY

a. Set the TRIGGER selector switch to FREE RUN and the PULSE AVERAGING switch to ON MAX RESET. Check the +5 V supply. Measure between A7J1 and A7J5. The voltage must be 5V ± 0.25 V.

b. Disconnect the digital display input from the rest of the instrument by removing the lead from Terminal A7 pin 11.

CAUTION

BE VERY CAREFUL TO GRASP THE METAL PORTION OF THE JACK WITH A PAIR OF PLIERS. DO NOT PULL ON THE WIRE. PULL STRAIGHT UP.

Connect the positive side of the precision supply to A7 pin 11 and the negative side to A7 pin 14.

c. Alternately apply +3 mV and +7 mV, and adjust the + BAL (A7R39) for a reading of + .001 and + .002 respectively.

d. Repeat step c using -3 mV and -7 mV, and adjust the - BAL (A7R38).

e. Apply +4.00 volts and use the +F.S. adjust (A7R41) to change the reading from .999 to 1.000 to 1.001 and adjust the 1.000 adjust (A7R84) for smooth transition with approx. equal intervals. Then set (A7R41) for a reading of 1.000.

f. Apply -4.00 volts and adjust -F.S. adjust (A7R21) for a reading of 1.000.

6.3.2.3 CALIBRATOR

a. Connect the counter to the calibrator output and measure the frequency. The frequency should be in the range from 103 MHz to 107 MHz. If the frequency is in the correct range, no adjustment is required. If it is beyond this range, it will be necessary to adjust the frequency by inserting a small screwdriver through a hole in the cover of the calibrator and adjusting A8C7 to obtain 105 MHz ± 1 MHz. There is a legend identifying the hole on the cover.

b. Set the calibrator switch to +10 dBm. Connect the detector of the precision power bridge to the calibrator output and adjust the calibrator output to exactly 10.00 mW using the CALIBRATOR OUTPUT ADJ on the rear panel. Disconnect the precision power bridge.

c. Connect the precision 30 dB attenuator and the 1018B detector to the output of the calibrator. Adjust the -20 dBm CAL control on the front panel for a reading of exactly 10.0 μW ± the calibration correction of the 30 dB attenuator.

d. Remove the 30 dB attenuator from the calibrator output and connect the 1018B detector to the calibrator output and set the CALIBRATOR switch to -20 dBm. The reading should be adjusted to 10.0 μW using A8R19. This adj. is accessable thru a hole in the calibrator cover.

6.3.2.4 TRIGGER CIRCUIT

a. Set the TRIGGER selector switch to EXT., the PULSE AVERAGING switch to ON MAX RESET and the TRIGGER DELAY to 00.0 ns. Adjust the pulse generator to give a positive 0.5 μs pulse at a 500 Hz repetition rate. Set the pulse amplitude to 2 V. Connect the pulse generator output to the TRIGGER input on the Model 1018B, the vertical input of the oscilloscope and to the external trigger input of the scope, using Tee connectors. Keep the length of cable between the external trigger input and the vertical input to a minimum. Connect a length of cable to the rear-panel REFERENCE PULSE output long enough to reach to the input of the scope.

b. Set the oscilloscope sweep to 0.1 μs /DIV, the trigger selector to external and adjust the display so that the rising edge of the pulse is 1 division in from the left edge. Remove the connection from the pulse generator to the vertical input but do not disturb the trigger connection. Connect the cable from the REFERENCE PULSE in its place. Set the vertical sensitivity to 0.5 V/DIV; you should see an 80 nS pulse.

c. Adjust A6R78 (DELAY ZERO) so that the trailing edge 50% point is four and one-half divisions in from the left edge of the display graticule. Thus the delay from the rising edge of the trigger pulse to the trailing edge of the reference pulse is 350 ns.

d. Remove the trigger cable from the oscilloscope and connect it to the "start" input of the Counter/Time Interval Meter. Connect the Reference Pulse to the "stop" input of the Counter. Set the TRIGGER DELAY control to 100μs (the "1" will not show in the window and the dial will read 00.0 and be near the clockwise end of its travel). Set the counter to have 100 ns resolution in the Time Interval mode with the slope set to "+".

e. Adjust A6R69 (DELAY CAL) to obtain a reading of 100.1 μs. This allows for the approximately 100 ns delay between the rising edge of the trigger pulse and the rising edge of the reference pulse.

6.3.2.5 INPUT CIRCUIT

The following checks and adjustments must be made with utmost care. Before making any adjustments, carefully read this entire section. Adjustments must be made in the order indicated.

a. Connect the power detector to the CALIBRATOR OUTPUT. Set the front panel controls as follows:

PULSE AVERAGING	ON MAX RESET
TRIGGER	FREE RUN
CAL FACTOR	0
CALIBRATOR	OFF
RANGE	10 mW DIRECT
DELAY	10 µS
-20 dBm CAL	Center of range (0V at A4 Pin 4)
+10 dBm CAL	Center of range

b. Connect the sensitive voltmeter between A4J6 and A4J3 (common). Adjust A4R160 for a reading of 0 V as closely as possible. The reading should be within 20 µ V of zero when adjusted properly.

c. Connect the digital voltmeter to A4J6 with the low side connected to A4J3. Turn the calibrator to +10 dBm. The reading should be 4.0 V ±40 mV. If it is not, adjust A9R22 to obtain 4.0 V as closely as possible. To gain access to the adjustment in the detector head assembly (A9), remove the two screws at the rear of the assembly, slide the retaining cap up the cable and grasp cylindrical outer cover and slide it back.

d. Set the pulse generator to give a 2 µs pulse at a repetition rate of 500 Hz. Using the oscilloscope to monitor the pulse, adjust the amplitude to be 0.5 V negative when terminated in 50Ω. Remember, a pulse of amplitude greater than 1.5 V may damage the detector. Now connect a 10 dB attenuator to the output of the pulse generator and connect the detector to the attenuator. Connect the oscilloscope (using a X 10 probe) to A4J6 with the common (ground) lead of the scope connected to A4J3. Use a short ground lead as the pulse has a rather rapid rise. Adjust A9R21 to obtain an overshoot-free response with the best rise-time. Use a pretrigger connected to the EXT TRIGGER INPUT of the 1018B. This same pulse is used to trigger the scope. Connect the vertical input of the scope to the A4J12. Set the 1018B TRIGGER DELAY to approximately 10µs. Set the scope sweep rate to 2µs/div. EXT TRIG. Set the scope vertical sensitivity to 10mV/div, AC coupled. Adjust SAMPLER NEUTRALIZING (A4R44) for minimum detected pulse. Remove the 10 dB Attenuator

e. Disconnect the pulse generator and connect the detector and 10dB attenuator to the calibrator. Turn the calibrator off and connect the sensitive voltmeter to A4J7 and A4J3 (common). Adjust A4R60 to obtain 0V ±1mV.

f. Move the voltmeter to A4J8 and adjust A4R86 to obtain 0 V ± 1 mV.

g. Move the voltmeter to A4 terminal 39 near the right side of the board. Adjust A2R32 (on the board fastened to the right side) to obtain 0 volts ± 200 µV.

h. Connect the voltmeter to A4J1 and the common side to A4J3. Adjust A4R7 to obtain 0 V ±100 µ V. Remove the voltmeter. Now set the -20 dBm CAL control for a reading of 000.0 µ W on the 100 µ W scale.

i. Disconnect the wire from Terminal A4-39. Connect the + output of the precision supply to A4J1 and the low side to A4J3 (common). Press the +10 dBm button and set the supply to 2.000V. Note the reading on the display. Set the supply to 0.200V and then to 0.020V. Each step should cause the display to change by 10.0 dB; adjust A4R12 to obtain this action. If, after adjusting A4R12, the change from 0.200V to 0.020V does not match the change from 2.000V to 0.200V, repeat step h and re-adjust A4R12.

j. Set the precision supply to the voltage which causes the display to read 0.0 dBm. This can be set very closely by noting when the display switches from + to -. Turn the CAL FACTOR lever switch to + and the rotary switch to 1.0 dB. Adjust A4R9 so that the display reads -1.0 dBm. Move the lever to - and check to see that the display reads +1.0 dBm. If necessary, readjust A4R9 so that both + and - settings read correctly. Remove the precision supply & reconnect the wire to terminal A4-39.

k. Connect 10 dB of attenuation between the output of the calibrator and the detector, turn the calibrator on and set the CAL FACTOR switch to compensate for the attenuator calibration difference from 10 dB. Adjust A4R98 so that the display reads 1.000 on the 1 mW range. Add an additional 10 dB of attenuation and note the reading. Remove the additional 10 dB and set A4R101 to cause the reading to be above or below 1 mW by twice the amount the reading with the attenuator was above or below .100 mW. For example, if the reading at 100 µ W was 0.105, then the reading at 1 mW should be set to be 1.010.

Now readjust A4R98 so that the display reads 1.000 mW and repeat the procedure. Continue until the display agrees at both 100 µ W and 1 mW. The final adjustment will have to be made using the 100 µ W range and the 1 mW range, and readings obtained must take into account the calibration of the attenuator used to go between 1 mW and 100 µ W.

l. In order to complete the measurements of and adjustments to the tracking controls it is necessary to have a table of readings to be expected from the Model 1018B as attenuation is inserted between the calibrator and the detector. The attenuation starts from 20 dB and is reduced in 1 dB steps to 0. It is required to make adjustments in the linear mode to take advantage of the maximum resolution available from the instrument. Therefore, you must multiply the linear calibration correction factor to each attenuation amount. For your reference a chart, shown in Table 6-1, converting dB corrections to linear is provided below. In addition, a chart, Table 6-2, showing uncorrected expected readings is provided with additional space allowed for you to write in the corrected values. You are urged to make a photocopy of the chart, write in the corrected readings and file it where it will be available along with the calibrated attenuator.

TABLE 6-1

ATTENUATOR CORRECTION FACTORS

CORRECTION FACTOR (dB)	LINEAR EQUIVALENT	
	+	-
.01	1.0023	.9977
.02	1.0046	.9954
.03	1.0069	.9931
.04	1.0093	.9908
.05	1.0115	.9886
.06	1.0139	.9863
.07	1.0162	.9840
.08	1.0186	.9817
.09	1.0209	.9795
.10	1.0233	.9772
.11	1.0257	.9750
.12	1.0280	.9727
.13	1.0304	.9705
.14	1.0328	.9683
.15	1.0351	.9660
.16	1.0375	.9638
.17	1.0399	.9616
.18	1.0423	.9594
.19	1.0447	.9572
.20	1.0471	.9550
.21	1.0495	.9528
.22	1.0520	.9506
.23	1.0544	.9484
.24	1.0568	.9462
.25	1.0593	.9440
.26	1.0617	.9419
.27	1.0641	.9397
.28	1.0666	.9375
.29	1.0691	.9354
.30	1.0715	.9332

m. Using the 1 mW scale, check the tracking from 100 μW to 1 mW. If necessary, adjust resistors A4R104 through A4R112 (adjustments A through E) to obtain proper tracking (within 1%). Start by adjusting A4R104 at the lowest input level and working up to A4R112 at successively higher levels. Do not move the adjustments much the first time through; repeat the procedure several times until the readings fall where they should. It is often the case that no adjustment is required, even when a new detector diode is installed as tracking at these levels is quite consistent from detector to detector. If a large adjustment is required it will be necessary to readjust A4R86, A4R98 and A4R101; see Sections f and k.

n. Using the 10 mW scale, check the tracking from 1 mW to 10 mW. If required, corrections can be made using adjustments f through m. Proceed from the lowest input, adjust A4R114 and work up to the highest input and adjust successively higher numbered resistors. Repeat the procedure as required to obtain the best tracking. When finished, the values obtained should be within 1% of the desired

TABLE 6-2

DISPLAY READINGS WITH ATTENUATION BETWEEN CALIBRATOR AND DETECTOR

ATTENUATOR LOSS (dB)	READING (mW)	CORRECTED READING
20	100.0 μW	
19	.1259	
18	.1585	
17	.1995	
16	.2512	
15	.3162	
14	.3981	
13	.5012	
12	.6310	
11	.7943	
10	1.000	
9	1.259	
8	1.585	
7	1.995	
6	2.512	
5	3.162	
4	3.981	
3	5.012	
2	6.310	
1	7.943	
0	10.00	

values. It may be required to have a given reading set slightly high or low to compensate for the next reading above or below a given input level. Also, you may find it useful to periodically reset the +10 dBm CAL adjustment on the front panel as the process goes on.

o. Connect the detector directly to the calibrator and adjust the +10 dBm CAL control to cause the instrument to read 10.00 mW as closely as possible. Press the +10 dBm button and adjust A4R17 so that the display reads +10.0 dBm.

p. Press the 20 dB coupler button and adjust A5R5 so that the display reads 30.0 dB.

q. Connect the precision supply + lead to A4J1 and the common lead to A7J3. Set the supply to cause the display to read +10.5 dBm and adjust A4R38 to the point where the OVER-RANGE light just comes on.

This completes the calibration procedure.

6.4 DETECTOR MAINTENANCE

CAUTION

The detector element mounted in the detector body (see Figure 6-1) can be damaged if the special handling precautions noted below are not observed. Before removing, installing, or handling the detector element in any way, be sure to read the precaution below.

6.4.1 DETECTOR ELEMENT HANDLING PRECAUTIONS

a. Before installing a detector element into the detector mount, discharge any static voltages that may exist between yourself and the mount by touching the mount.

b. When handing a detector element to another person, discharge static voltage by touching hands before passing the element.

c. Do not use ohmmeters to check the detector elements since the voltages and currents available from most such meters can easily damage the sensitive diodes used in these elements.

6.4.2 REPLACING THE DETECTOR ELEMENT

Refer to Figure 6-1 for identification of the parts mentioned in this procedure.

a. Unscrew the Cap Assembly from the Detector Housing. In separating these parts use a pair of pliers with plastic jaws or protect parts with heavy paper or tape.

b. Remove the detector element and, if included, the ring from the detector housing assembly. (Older detectors may have a capsule spacer and capacitive washer. Remove these. They will be replaced by the ring included in the kit. If your detector has just the ring, replace it with the new ring from the kit.)

c. Late model detectors have only the detector element; no spacer, washer, or ring. If your detector has no spacer, washer or ring, then discard the ring from the kit and replace just the element as shown in Figure 6-1. Make sure that component(s) are correctly seated and pressed firmly into the detector.

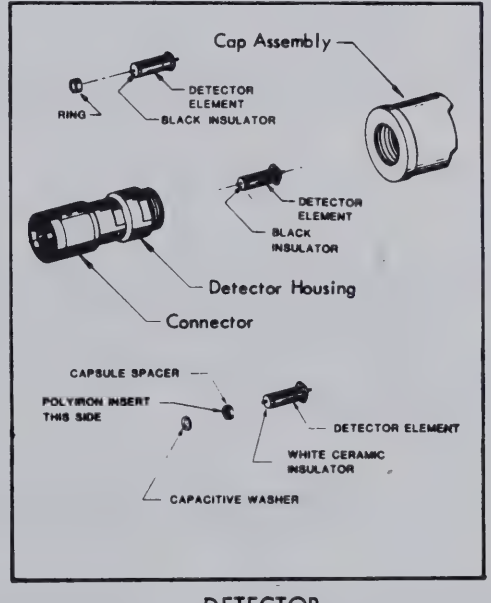
WARNING: USE CARE WHEN INSERTING THE DETECTOR ELEMENT INTO THE HOUSING TO AVOID DAMAGING THE FEMALE SOCKET CONTACTS.

d. Replace the Cap Assembly onto the Detector Housing and tighten firmly.

e. Remove the old calibration label since its data will no longer apply. Leave the warning label on the Cap Assembly.

f. Calibrate the instrument using your manual, Refer to Section 6.3.2.5 Input Circuit.

h. To replace cable or cap assembly, order Cap & Assy 14034.



DETECTOR
FIGURE 6-1

6.5 TROUBLE SHOOTING

In order to localize the source of trouble in an instrument such as this, it is necessary to have a rather detailed working knowledge of the instrument. You are urged to read carefully Section 5 on Circuit Description and make use of the circuit diagrams.

6.5.1 LOCALIZATION OF TROUBLE

Use Trouble Shooting Table 6.3. Also make use of the test point information in Section 6.2.

After the trouble has been found and corrected, the calibration should be checked as outlined in Section 6.3.

TABLE 6-3 TROUBLE SHOOTING

INDICATION	CHECK
NO DIGITAL DISPLAY	1. Power Cord. 2. Fuse (F1); F1 is 1.0 A 250 V. 3. POWER switch, S1. 4. Transformer, T1.
DIGITAL DISPLAY DOES NOT CHANGE	1. Digital display board, A7. 2. Trigger selector set to wrong position. 3. Display rate set to EXT. 4. Trigger circuit, A6.
INSTRUMENT PROVIDES MEANINGLESS DISPLAY.	1. Check that the +5 V supply is operating at A7J1. 2. Check the absolute value circuit by performing the calibration for the digital display. 3. Check A7U4 pin 8 to see if there are 40 clock pulses occurring after each trigger. 4. Check the output of the control state decoder as shown in Table 6-5. 5. Determine that the voltage at A7 pin 11 is constant during the counter period.
OUT OF CALIBRATION ON BOTH LINEAR AND LOG MODES.	1. Detector. 2. Power supplies, A1. 3. Input amplifier, A4J6. 4. Sample-and-hold circuits and shaper amplifier on A4. 5. Output amplifiers on A4.
OUT OF CALIBRATION ON LOG MODES.	1. Oven, A4J5. 2. Log output amplifier, A4QA2 and associated circuitry.
CANNOT BE CALIBRATED AT -20 dBm.	1. Chopper amplifier, A4.
LARGE CHANGE IN READING WITH CHANGES IN DISPLAY RATE.	1. Sample-and-hold circuits on A4.

6.5.2 LOCALIZATION OF TROUBLE TO INDIVIDUAL COMPONENTS

To determine whether a component is defective, it may be necessary to make active or passive circuit checks, as well as waveform measurements. Where allowed by circuit voltages, the performance of a transistor that is forward-biased can usually be determined by shorting the base to the emitter or by opening the base circuit. The transistor will be turned off in either case unless it is shorted. Performance may be determined by monitoring circuit parameters. A transistor can be assumed to be open if it does not conduct when its base-to-emitter voltage exceeds turn on.

When checking the FET's used in the Model 1018 B, shorting the source to gate will result in turn on unless the FET is open. Under normal operating conditions these FET's operate with a negative bias of less than 2 V between the gate and source and a source to drain voltage of at least 5 V unless the unit is shorted. Ohmmeter measurements may be made on the source-gate junction as long as the precautions mentioned below are observed. Back biased, the source-gate junction should be essentially open.

Open or shorted transistors may also be located through resistance measurements across the elements. Exact values cannot be given due to the differences in transistors; however, the ratio of forward and backward emitter-collector resistance is normally between 10:1 and 100:1. Higher power transistors have the lower ratios. If it is determined that a transistor is defective, look for other defective elements in the circuit that may have resulted from, or caused the transistor failure.

When checking resistors and capacitors, one lead should be disconnected to prevent shunt paths and possible damage to diodes and transistors.

CAUTION

1. USE OF OHMMETER. Some ohmmeters may supply sufficient voltage or current to damage transistors. Before using an ohmmeter to check transistors or to make measurements in transistor circuits, be sure to check the voltage and current output of the ohmmeter on the range to be used. The open circuit voltage should not exceed 1.5 V and the short circuit current should not exceed 3 mA or transistors may be damaged. Never use an ohmmeter to check the detector diode. The only safe way to check the detector is to measure the voltage on TP18 (A4J8) with RF input into the detector.
2. MEASURING TRANSISTOR VOLTAGE Do not measure the base-to-emitter voltage of a transistor directly because auxiliary currents may damage the transistor. Measure the voltage independently with respect to ground.

6.6 PARTS REPLACEMENT

6.6.1 REPLACEMENT OF PARTS ON PRINTED CIRCUIT BOARDS

Before removing a component from a PC board, carefully note its orientation. Apply heat sparingly to the component lead. Be sure that the soldering iron is grounded to prevent leakage current from damaging the other components. The simplest way to remove a component with three or more leads is to cut the leads and then unsolder the remaining leads from the PC board. Clear the solder from the PC board holes with a toothpick or an awl for ease of insertion of the new component. To replace the component, form and cut the leads so that they extend approximately 1/16" through the PC board when the component is in position. Whenever possible hold the component lead with a tool that will act as a heat sink and solder the lead from the opposite side. Avoid overheating and use a good quality rosin core solder. Cut off excess lead length and clean off any excess flux.

A break in the etched copper conductor may be repaired by soldering a piece of copper wire across the break. If the bond between the etched copper conductor and the base material fails, secure the conductor in place with a cement having good electrical insulating properties.

6.6.2 REPLACEMENT OF PARTS ON THE FRONT PANEL

To replace the parts mounted on the front panel remove the screws indicated in Figure 6-2. Carefully pull the panel straight out from the rest of the instrument. When reassembling the panel to the instrument use care to be sure that all switches come through their slots properly and that no wires are pinched between mating sheet metal parts.

6.6.3 REMOVING PLUG-IN PRINTED CIRCUIT BOARDS

The upper portion of the rear panel serves as a hold-down for the plug-in printed circuit boards. Access to these circuit boards is gained by removing the top cover and the upper portion of the rear panel.

6.6.4 REMOVAL OF THE CALIBRATOR

The calibrator assembly is fastened to the rear of the instrument by two screws. Refer to Figure 6-3 to determine which screws need to be removed. You should NOT remove any screws not required in the removal procedure.

6.6.5 SEMICONDUCTOR DEVICES

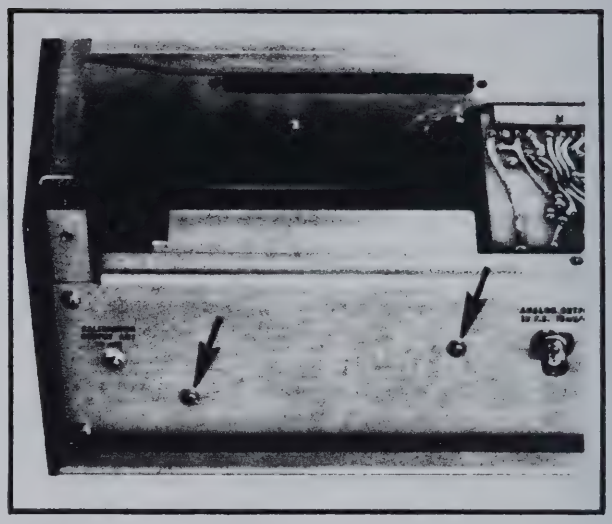
A variety of semiconductor devices is used in this instrument. The type numbers shown are either EIA registered numbers or manufacturer's numbers and these devices may be used for replacement purposes. Individual instruments may have equivalent devices of other manufacturers installed and the type number may not agree with those shown.

6.6.6 DETECTOR CABLE STORAGE

Whenever the instrument is to be stored for any period or moved reinsert the detector cable and detector into the front of the instrument by carefully shoving the cable into the cavity approximately 3 inches at the time. If the cable binds due to its inherent stiffness, lift the instrument onto its side and loosen the bind by jiggling the cable through the access hole provided in the bottom panel.

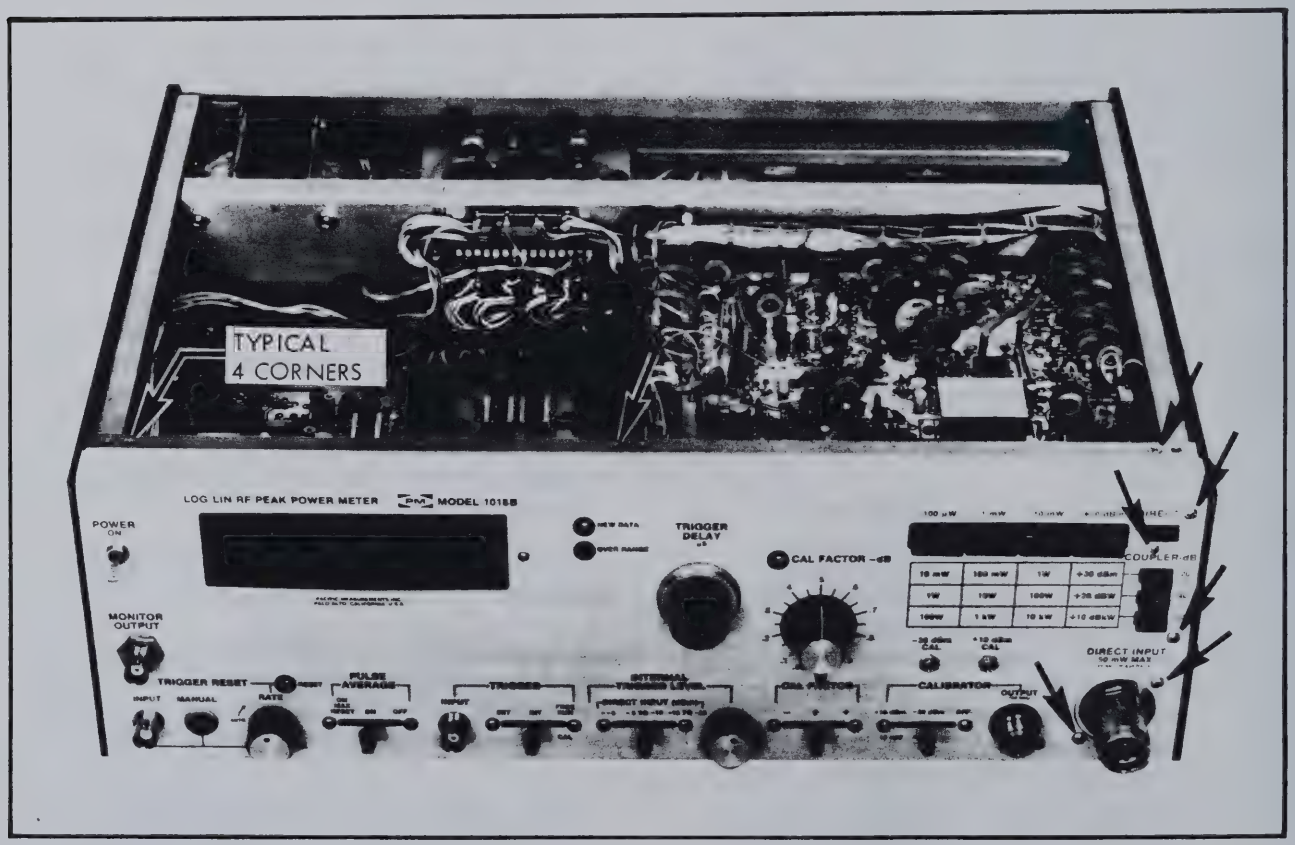
6.6.7 ACCESS TO RANGE SWITCH PC (A2)

To gain access to the back of the Range Switch PC board it is necessary to release the panel as indicated in paragraph 6.6.2 and remove the three screws that secure the PC board to the side of the chassis.



CALIBRATOR MOUNTING SCREWS

FIGURE 6-3



FRONT PANEL MOUNTING SCREWS

FIGURE 6-2

6.7 WIRE LIST

TABLE 6-4

J1 LINE VOLTAGE CONNECTOR & S1 POWER SWITCH

FROM	TO	COLOR	COMMENT
T1-1	J1-C	BRN-WHT	
T1-2	J1-D	ORG-WHT	
T1-3	J1-A	BRN-YEL	
T1-4	J1-E	YEL-WHT	
T1-5	J1-F	GRY-WHT	
S1-A (Arm)	J1-H	RED	4 Conductor Shielded Cable
S1-A (N.O.)	J1-B	BLK	4 Conductor Shielded Cable
S1-B (Arm)	J1-M,N,P	GRN	4 Conductor Shielded Cable
S1-B (N.O.)	J1-L	WHT	4 Conductor Shielded Cable
			Shield from the 4 Conductors Cable to Chassis Ground

J4 (A1) (Assembly 10121) POWER SUPPLY

FROM	TO	COLOR	COMMENT
J4-1	Q1-B	BLU	+12.6 V Pass Transistor
J4-2	Q1-E	RED-WHT	+12.6 V (TB3-3&4)
J4-3	T1-10	GRN-WHT	9.7 V A.C.
J4-4	T1-11	GRN-WHT	9.7 V A. C.
J4-8	Q2-E	BLK-WHT	Common 2
J4-8	TB2-2	BUS WIRE	Common 2
J4-9	TB3-1&2	BUS WIRE	-12.6 V
J4-13	Q2-B	GRN	-12.6 V Pass Transistor

A2 (Assembly 13530) RANGE SWITCH & LAMP DRIVERS

FROM	TO	COLOR	COMMENT
A2-1	TB3-1&2	PUR-WHT	-12.6 V
A2-2	TB3-3&4	RED-WHT	+12.6 V
A2-3	TB2-3&4	BLK-GRN	Ground 1
A2-4	A4-39	BLU-WHT	
A2-5	A5-27	BLK-GRN	Inner Conductor 50 Ω Coax.
A2-3		BLK-GRN	Outer Conductor 50 Ω Coax.
A2-6	TB4-4	ORG	+5 V
A2-7	Assy 13424-Pin 4	GRY-WHT	mW
A2-8	Assy 13224-Pin 3	WHT	μW
A2-10	A4-35	GRN	
A2-11	A4-30	GRN-WHT	
A2-12	A4-27	BLU-WHT	
A2-13	A4-31	ORG-WHT	
A2-14	A4-26	GRY-WHT	
A2-15	A4-32	BLU-WHT	
A2-16	A7-39	BLU	Decimal 10^{-1}
A2-17	A4-28	BRN-WHT	
A2-18	A4-29	YEL	
A2-19	A4-25	GRN-YEL	
A2-20	A7-30	YEL-WHT	Decimal 10^{-2}
A2-21	A7-37	GRN-WHT	Decimal 10^{-3}
A2-22	A4-38	BRN	
A2-23	Assy 13424-Pin 6	YEL-WHT	dB
A2-24	A7-36	WHT	Polarity on-off
A2-25	Assy 13424-Pin 5	BLU-WHT	Kw
A2-26	Assy 13424-Pin 2	BRN-WHT	W
A2-27	A1(cw)	BLK-YEL	Inner Conductor 50 Ω Coax.
A2-28		BLK-YEL	Outer Conductor 50 Ω Coax.
A2-29	A6-9	ORG-GRN	
A2-30	A5-24	BLU	

TABLE 6-4 (CONT)

A4 (Assembly 13525) INPUT CIRCUIT

FROM	TO	COLOR	COMMENT
A4-1	A5-9	RED	+150 V
A4-2	R1-(Arm)	BLK	Inner Conductor, 50Ω Coax.
A4-3		BLK	Outer Conductor, 50Ω Coax.
A4-4	R3-(Arm)	BLU-WHT	
A4-5	S3-3	BLK-ORG	Inner Conductor, 50 Ω Coax.
A4-6	R6 & R8	BLK-ORG	Outer Conductor, 50 Ω Coax.
A4-7	TB3-1&2	PUR-WHT	-12.6 V
A4-8	TB3-3&4	RED-WHT	+12.6 V
A4-9	A9-1	RED	+12.6 V
A4-10	A9-4	BLU	-12.6 V
A4-11	A9-7	WHT	Common 1, Outer Conductor 50 Ω Coax.
A4-12	A9-6	WHT	Input/Inner Conductor 50 Ω Coax.
A4-13	A9-C8	DRAIN WIRE	(Chassis Ground)
A4-14	A9-3	YEL	Chopper Output
A4-15	A9-2	GRN	Chopper Input
A4-16	A9-8	BRN	Common Reference
A4-17	CR9	GRN	Overrange
A4-18	TB4-3	BLK	5 V Common (Ground 3)
A4-19	A7-1	BRN-WHT	
A4-25	A2-19	GRN-YEL	
A4-26	A2-14	GRY-WHT	
A4-27	A2-12	BLU-WHT	
A4-28	A2-17	BRN-WHT	
A4-29	A2-18	YEL	
A4-30	A2-11	GRN-WHT	
A4-31	A2-13	ORG-WHT	
A4-32	A2-15	BLU-WHT	
A4-33	S7-A (Arm)	BLK	Cal. Factor Polarity
A4-34	A10-5	RED	Linear Cal Factor
A4-35	A2-10	GRN	
A4-36	A7-11	WHT	
A4-37	A10-6	GRY-WHT	Log Cal Factor
A4-38	A2-22	BRN	
A4-39	A2-4	BLU-WHT	
A4-40	TB3- 1&2	PUR-WHT	-12.6V
A4-40	TB3-3&4	RED-WHT	+12.6V
A4-42	A6-31	BLK-ORG	Outer Conductor 50 Ω Coax.
A4-43	A6-6	BLK-ORG	Inner Conductor 50 Ω Coax
A4-44	TB4-1&2	BLK-GRN	Ground 2
A4-45	J7	BLK	Inner Conductor, 50 Ω Coax.
A4-46	J7	BLK	Outer Conductor, 50 Ω Coax.
A4-47	TB4-4	ORG	+5 V
A4-44	A7-14	BLK-GRN	(A44 - TB4-3&4 Ground 1)

A5 (Assembly 13546) RECTIFIER & dB OFFSET CIRCUIT

FROM	TO	COLOR	COMMENT
A5-1	T1-8	BLU-WHT	15 V AC (+12.6 V Supply)
A5-3	T1-9	BLU-WHT	15 V AC (+12.6 V Supply)
A5-5	T1-6	WHT	15 V AC (-12.6 V Supply)
A5-7	T1-7	WHT	15 V AC (-12.6 V Supply)
A5-10	T1-14	YEL-WHT	150 V AC
A5-11	T1-15	YEL-WHT	150 V AC
A5-13	T1-17	BLK-WHT	8.2 AC Center Tap
A5-14	T1-16	ORG-WHT	8.2 V AC
A5-15	T1-18	ORG-WHT	8.2 V AC

TABLE 6-4 (Cont)

A5-2	Q1-C	RED-GRN	+12.6V Supply Pass Transistor
A5-4	TB2-1&2	BLK-WHT	Ground 2
A5-6	Q2-C	BLU	-12.6V Supply Pass Transistor
A5-9	A4-1	RED	+150V
A5-17	U1-1 (TB4-1)	WHT	+5V Supply Input
A5-16	U1-3 (TB4-2&3)	BLK-ORG	5V Common (Ground 3)
A5-28	TB2-3&4	BLK-GRN	Ground 1
A5-8	TB3-1&2	PUR-WHT	-12.6V
A5-27	A2-5	BLK-GRN	Inner Conductor 50Ω Coax
-	A2-3	BLK-GRN	Outer Conductor 50Ω Coax
A5-26	S9-B2 & 3	BLK-ORG	Inner Conductor 50Ω Coax
-	S9-B&D (Arm)	BLK-ORG	Outer Conductor 50Ω Coax
A5-24	A2-30	BLU	
A5-25	TB3-1 & 2	PUR-WHT	-12.6V

A6 (Assembly 13522) TRIGGER CIRCUIT

A6-1	S4-D2	YEL-WHT	
A6-2	S4-D3	ORG-WHT	
A6-3	J-9	BLK	Outer Conductor 50Ω Coax
A6-4	J-9	BLK	Inner Conductor 50Ω Coax
A6-5	A6-38	BUS WIRE	
A6-6	A4-43	BLK-ORG	Inner Conductor 50Ω Coax
A6-31	A4-42	BLK-ORG	Outer Conductor 50Ω Coax
A6-7	R9-CCW	BRN-YEL	
A6-8	R9-CW	BLU-WHT	
A6-9	A2-29	ORG-GRN	
A6-10	J2	BLK	Outer Conductor 50Ω Coax
A6-11	J2	BLK	Inner Conductor 50Ω Coax
A6-12	R6 & R8	BRN	Outer Conductor 75Ω Coax
A6-13	R7 (Arm)	BRN	Inner Conductor 75Ω Coax
A6-14	TB3-1 & 2	PUR-WHT	-12.6V
A6-15	TB3-3 & 4	RED-WHT	+12.6V
A6-16	TB2-1 & 2	BLK-WHT	Ground 2
A6-17	S9-A1	RED	3 Conductors Shielded Cable*
A6-18	S10-(Arm)	GRN-WHT	
A6-19	S4-B1	WHT	3 Conductors Shielded Cable*
A6-20	S9-D3	GRY-WHT	
A6-22	R10-(Arm)	ORG-YEL	
A6-23	CR6	ORG-WHT	
A6-25	S5-A	GRN-WHT	
A6-26	S5-B	YEL-WHT	
A6-27	J5	BLK-GRN	Inner Conductor 50Ω Coax
A6-28	J5	BLK-GRN	Outer Conductor 50Ω Coax
A6-30	S4-C-(Arm)	BRN-WHT	
A6-32	TB4-4	ORG	+5V
A6-35	CR-8	YEL	Cal Factor On
A6-29	CR-7	BLU-WHT	
A6-38	R9-(Arm)	GRN-YEL	

*Shield from the 3 Conductors Cable to Chassis Ground.

©

Table 6-4 (Cont.)

A7 (Assembly 13342) DIGITAL DISPLAY

FROM	TO	COLOR	COMMENT
A7-1	A4-19	BRN-WHT	
A7-8	TB4-3	BLK	5V Common (Ground 3)
A7-7	TB4-4	ORG	+5V
A7-10	TB3-3&4	RED-WHT	+12.6V
A7-11	A4-36	WHT	
A7-12	TB3-1&2	PUR-WHT	-12.6V
A7-14	A4-44	BLK-GRN	Ground 1
A7-15	S4-B-(Arm)	BLK	From 3 Conductors Cable
A7-36	A2-24	WHT	Polarity On-Off
A7-37	A2-21	GRN-WHT	Decimal 10^{-3}
A7-38	A2-20	YEL-WHT	Decimal 10^{-2}
A7-39	A2-16	BLU	Decimal 10^{-1}
A7-41	J-8	BRN-YEL	Analog Output
A7-32	TB4-3	BLK	5V Common (Ground 3)

A8 (Assembly 13694) CALIBRATOR

FROM	TO	COLOR	COMMENT
A8-FL3	TB2-3&4	BLK-GRN	Ground 1
A8-FL4	S-6-B2&3	RED-YEL	+12.6V Switched Calibrator
A8-FL1	S6-A ARM	BRN	
A8-FL5	S6-D2	GRN	
A8-FL2	R-11 ARM	YEL	
A8-FL3	R-11 CCW	BLK-GRN	
A8-FL1	R-11 CW	BRN	

A9 (Assembly 14902) DETECTOR ASSEMBLY

FROM	TO	COLOR	COMMENT
A9-1	A4-9	RED	+12.6V
A9-2	A4-15	GRN	Chopper Output
A9-3	A4-14	YEL	Chopper Input
A9-4	A4-10	BLU	-12.6V
A9-6	-	WHT	Output/Input Inn Conductor 50Ω Coax
A9-7	A4-11	WHT	Common 1 & Outer Conductor 50Ω Coax
A9-8	A4-16	BRN	Common Reference
A9-C8	A14-13	DRAIN WIRE	Chassis Ground

CHASSIS

FROM	TO	COLOR	COMMENT
Q1-E	J4-2	RED-WHT	+12.6 V
J4-2	TB3-3&4	WIRE	+12.6V
Q1-B	J4-1	BLU	
Q1-C	A5-2	RED-GRN	
Q2-B	J4-13	GRN	
Q2-C	A5-6	BLU	
Q2-E	J4-8	BLK-WHT	Ground 2
J4-8	TB2-1&2	BUS WIRE	Ground 2
U1-3	TB4-3	BUS WIRE	5V Common
TB4-3	TB2-1&2	BLK	Ground 2
U1-2	TB4-4	BUS WIRE	+5V
U1-1	TB4-1	BUS WIRE	
S6-B (ARM)	R3-CW	RED-WHT	+12.6V
S7-B1	R10-CCW	RED-WHT	+12.6V
R10-CCW	TB3-3&4	RED-WHT	+12.6V
S7-B1	R3-CW	RED-WHT	+12.6V

Table 6-4 (Cont)

FROM	TO	COLOR	COMMENT
S7-B3	R3-CCW	PUR-WHT	-12.6V
R10-CW	S4A ARM	BLK-GRN	Ground 1
R10-CCW	S6-D ARM	PUR-WHT	-12.6V
S5-C	TB2-1&2	BLK-WHT	Ground 2
S7-D 1&3	TB4-2&3	BLK	Ground 3
S7-B2	R 10	BLK-WHT	Ground 2
CR1,2,3,4,5	TB4-2&3	BLK	Ground 3
S7-B2&D 1&3	S4-D(ARM)	BLK-GRN	Ground 1
Assy. 13424-1	CR6	BLK	Ground 3
J8	TB2-3&4	BLK-GRN	Ground 1
CR-9	TB4-4	ORG	+5V
CR-8	S7-D ARM	GRN	
S4-B1	S9-A2&3	WHT	
S9-A ARM	S4-B2&3	BRN	
A10-2	S7-A3	BRN-WHT	
A10-3	S7-A2	BLU-WHT	
A10-4	S7-A1	YEL-WHT	
A10-1	S7-B ARM	GRN-WHT	
J6	J5	BLK-GRN	50 Ω Coax
J3	J9	BLK	50 Ω Coax
S9-B2&3	S4-A-1	BLK-ORG	Inner Conductor
S9-B&D ARM	S4-A ARM	BLK-ORG	Outer Conductor 50 Ω Coax
S4-A ARM	R10 CW	BLK-GRN	Ground 1
R7-CCW	S3(R-8)	BRN-WHT	
R7-CW	S3-B ARM	BLU-WHT	
R3-CW	S6-B ARM	RED-WHT	+12.6V
TB3-1&2	S7-B3	PUR-WHT	-12.6V
S5-C	S4-D ARM	BLK-WHT	Ground 2
S4-C 2&3	S7D-1&3	BLK	Ground 3
S4-C ARM	S10 OPEN	BRN-WHT	
R10-CW	TB2-3&4	GRN-BLK	Ground 1

6.8 ACTIVE DEVICE VOLTAGES, WAVEFORMS, TIMING DIAGRAMS AND FUNCTIONAL DIAGRAMS

The following tables and oscillograms are provided to assist in locating troubles and malfunctions within the instrument. Due to manufacturing tolerances and variations in adjustments, the measured values in a given instrument may vary slightly from those listed.

The following are the conditions under which the measurements were made (unless otherwise indicated):

Line voltage:	115 V ac
Ambient temperature:	27°C
Warm-up time:	>0.5 Hour

Control settings:

Power:	ON
Trigger reset rate:	MAX
Pulse averaging:	OFF
Trigger:	FREE RUN
Internal trigger level:	>-5 dBm and MIN
Cal factor:	0 and .05 dB
Calibrator:	+10 dBm
Trigger delay:	99.9 µs
Range:	+10 dBm DIRECT
-20 and +10 dBm Cal:	Adjusted after 0.5 hour warm-up period.

All voltage and waveform measurements were made using an oscilloscope with a 10:1 divider probe attached. The impedance of the probe is represented by 10 MΩ shunted by <10 pF. Direct (dc) coupling was used in every case; dc values are average, as estimated from the display. All measurements are with respect to signal common (black test jacks).

CHASSIS (Assembly 13468)

DEVICE	EMITTER	BASE	COLLECTOR	COMMENT
Q1	+12.6	+12	+18	See A1
Q2	0	+0.6	+6	See A1

A1 ±12.6 VOLT POWER SUPPLY (Assembly 10121)

DEVICE	EMITTER	BASE	COLLECTOR	COMMENT
A1Q1	0	+0.6	+12	
A1Q2	-0.6	0	+0.6	
A1Q3	-0.6	0	+12.6	
Q1	+12.6	+12	+18	TP1
A1Q4	+0.6	+1.2	+11.5	
A1Q5	-7	-6.4	+1.2	
A1Q6	-7	-6.4	0	
Q2	0	+0.6	+6	TP3

A2 RANGE SWITCH AND LAMP DRIVER (Assembly 13530)

DEVICE	EMITTER	BASE	COLLECTOR	COMMENT
A2Q1	+6.3	+8	0	Same as A2Q2 when µW light is lit.
A2Q2	+6.3	+5.7	+6.3	
A2Q3	+6.3	+8	0	Same as A2Q2 when W light is lit.
A2Q4	+6.3	+8	0	Same as A2Q2 when KW light is lit.
A2Q5	+6.3	+5.7	+6.3	
A2Q7	Fig. 6-5	Fig. 6-4	Fig. 6-6	
A2Q8	-12.6	Fig. 6-6	Fig. 6-7	

Continued

A2 RANGE SWITCH AND LAMP DRIVER (Contd)

	Source	Drain	Gate
	Pin 1	Pin 2	Pin 3
A2Q6	+8	+8	Fig. 4
	Source 1	Drain 1	Gate 1
	Pin 1	Pin 2	Pin 3
A2Q9	+9	+12.6	+8
	Source 2	Drain 2	Gate 2
	Pin 5	Pin 6	Pin 7
A2Q9	+9	+12.6	+8

	PIN	2	3	4	1/5	6	7	
A2U1		-	+8	-12.6	-	+8	+12.6	J1
A2U2		+9	+9	-12.6	-12.6	+8	+12.6	
A2U3		-	+8	-12.6	-	+8	+12.6	J3

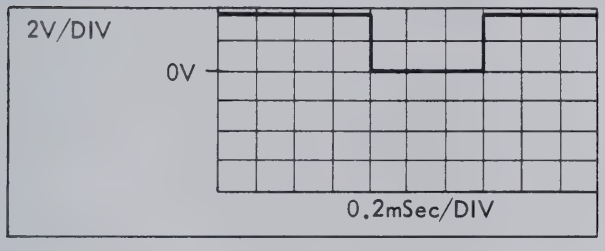


FIGURE 6-4

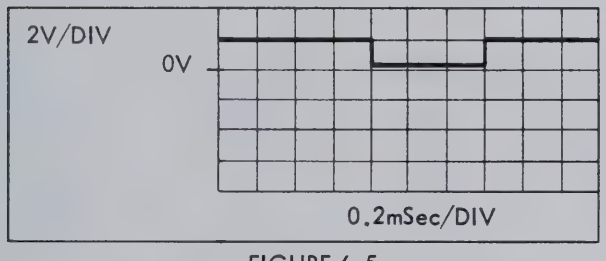


FIGURE 6-5

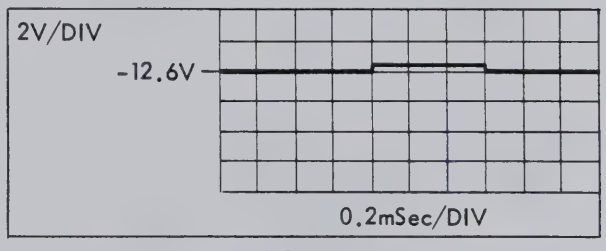


FIGURE 6-6

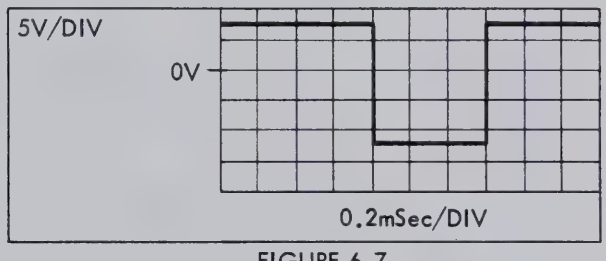


FIGURE 6-7

A4 INPUT CIRCUIT (Assembly 13525)

DEVICE	EMITTER	BASE	COLLECTOR	COMMENT
A4Q2	-0.6	0	0	Note 1 J4 and J1
A4Q3	-0.6	0	0	Note 1 J4 and J1
A4Q4	-12.5	-12	+12.6	J5
A4Q5	+0.6	0	-8	
A4Q6	0	0/+0.6	+18/0	Overrange OFF/ON
A4Q8	+4	+4.6	+12.6	
A4Q11	-6.3	-5.7	Fig. 6-8	
A4Q12	+9	+8.4	Fig. 6-8	
A4Q13	+9	+8.4	0	
A4Q14	Fig. 6-9	Fig. 6-8	+12.6	
A4Q15	+6	+6	-12.6	J10 Fig. 6-10
A4Q17	-12.6	-12	-12	J11 Fig. 6-11
A4Q20	-6.3	-5.7	+6	
A4Q21	+9	+8.4	-3	
A4Q22	+9	+8.4	-1	
A4Q23	-0.6	0	+46	
A4Q24	+45	+46	+150	J8
A4Q26	Fig. 6-12	Fig. 6-12	-9	
A4Q27	-9.6	-9	Fig. 6-12	
A4Q28	-9.6	-9	Fig. 6-12	
	Source Pin 1	Drain Pin 2	Gate Pin 3	
A4Q31	-3.5	-12.6	0	
A4Q32	0	Fig. 6-13	Fig. 6-12	J9

	Drain Pin 1	Source Pin 2	Gate Pin 3	Pin 4	
A4Q9	-	+4	-12.6	0	J6 and J10 Fig. 6-10
A4Q18	+4	Fig. 6-9	-12	Fig. 6-9	J7 and J11
A4Q29	0	0	Fig. 6-12	0	
A4Q30	0	0	Fig. 6-12	0	

	Source 1 Pin 1	Drain 1 Pin 2	Gate 1 Pin 3	
A4Q1	+1.2	+12.6	0	J1
A4Q10	Fig. 6-8	+8.4	-	
A4Q19	+6	+8.4	+4	

	Source 2 Pin 5	Drain 2 Pin 6	Gate 2 Pin 7
A4Q1	+1.2	+12.6	0
A4Q10	Fig. 6-8	+8.4	Fig. 6-8
A4Q19	+6	+8.4	+4

PIN	2	3	4	5	6	7	
A4U1	+1.2	+1.2	-12.6	-12.6	-6	+12.6	J1 and J2
A4U2	0	0	-12.6	-	+0.5	+12.6	J2
A4U3	-0.5	-0.5	-12.6	-	-10	+12.6	Overrange off
A4U7	-0.6	-0.6	-12.6	-12.6	0	+12.6	

Note 1: Measure emitter at J4 and collector at J1.

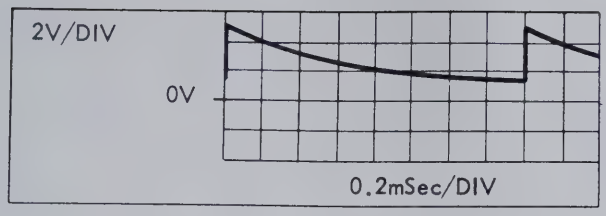


FIGURE 6-8

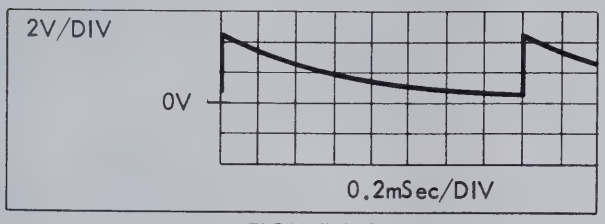


FIGURE 6-9

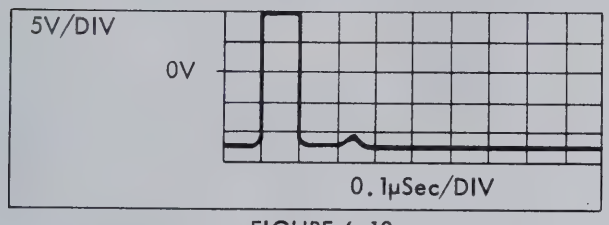


FIGURE 6-10

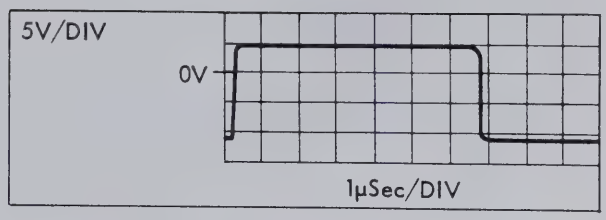


FIGURE 6-11

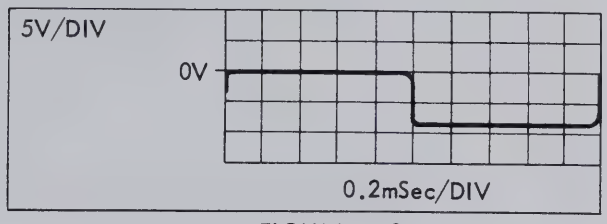


FIGURE 6-12

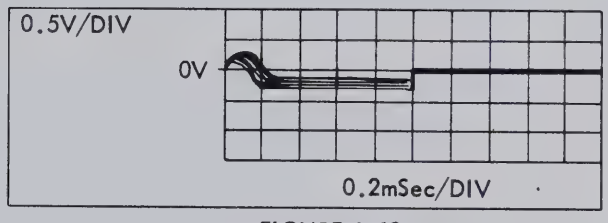


FIGURE 6-13

A5 RAW SUPPLIES (Assembly 13546)

DEVICE	EMITTER	BASE	COLLECTOR	COMMENT
A5Q1	+150	+150	+200	
A5Q2	0	0/+0.6	+8/0	Calibrator Output +10 dBm/-20 dBm
A5Q4	-8	-7.2	0	

A6 TRIGGER CIRCUIT (Assembly 13522)

DEVICE	EMITTER	BASE	COLLECTOR	COMMENT
A6Q1	0	+0.6/0	0/+18	Reset Light ON/OFF
A6Q2	0	0	0→+1.6	No Trigger (Trigger Internal)
A6Q3	0→+1	0→+1.6	+5	No Trigger (Trigger Internal)
A6Q4	0	0→+0.6	+1.5→+5	No Trigger (Trigger Internal)
A6Q5	0	0	+5	
A6Q6	+5	0	+0.6	
A6Q9	-6.3	-6.9	-12.6	
A6Q10	0	0→+0.6	0→+5.6	With Trigger Reset Rate Set to 9 o'clock
A6Q11	+6.2	+5.6	0	
A6Q12	0	0/+0.6	+16/0	New Data Light OFF/ON
A6Q13	+15.5	+15	0/+16	New Data Light OFF/ON
A6Q14	+16	+15.5	0/+16	New Data Light OFF/ON
A6Q15	Fig. 6-14	Fig. 6-15	-12.6	
A6Q16	0	Fig. 6-16	Fig. 6-17	
A6Q17	Fig. 6-18	Fig. 6-19	Fig. 6-17	
A6Q18	Fig. 6-20	Fig. 6-21	Fig. 6-17	

Continued

A6 TRIGGER CIRCUIT (Contd)

A6Q19		Fig. 6-18		Fig. 6-17		Fig. 6-21	
A6Q20		Fig. 6-22		+5		+12.6	Note 1
A6Q21		Fig. 6-20		Fig. 6-22		+12.6	
	PIN	2	3	4	6	7	8
A6U2		0	0	-6.3	-		+12.6
A6U7		+5.6	0 +5.6	-12.6	-11	+12.6	-
	PIN	2	3	4	6	12	13
A6U1		0	0	0	-12.6	-	+12.6

With Trigger Reset Rate Set to 9 o'clock.

Pulse Amp. With AC Gain Of 32 and Non-inverting.

Note 1: The voltage on the base depends on where the Trigger Delay is set. At 0 delay the voltage is slightly positive and 100 μ Sec delay is +5 volts.

Note 2: See Figure 6-23 for A6 Functional Diagram and Figure 6-24 for A6 Timing Diagram.

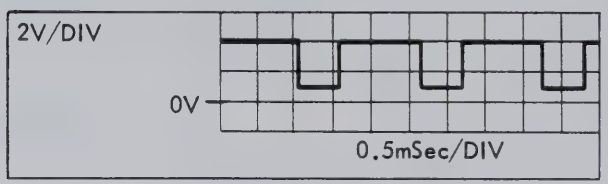


FIGURE 6-14

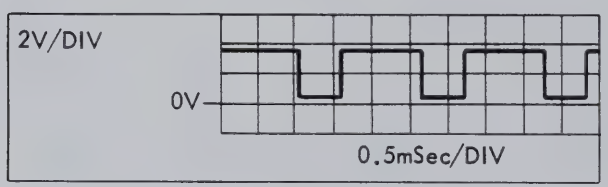


FIGURE 6-15

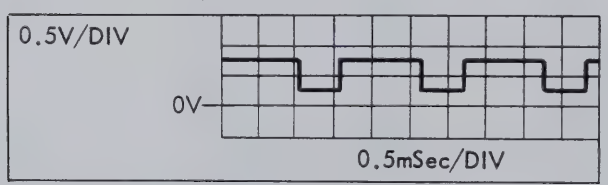


FIGURE 6-16

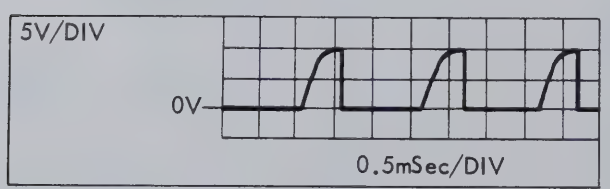


FIGURE 6-17

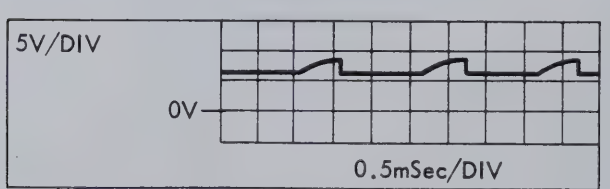


FIGURE 6-18

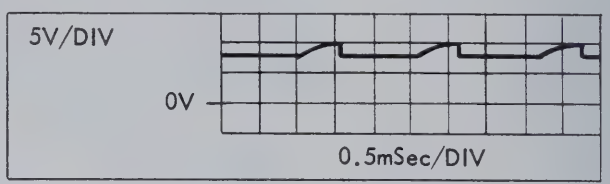


FIGURE 6-19

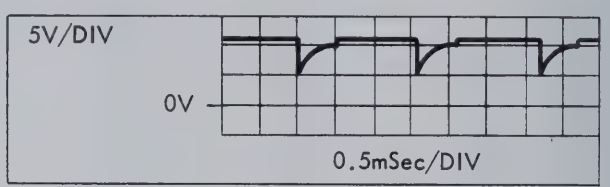


FIGURE 6-20

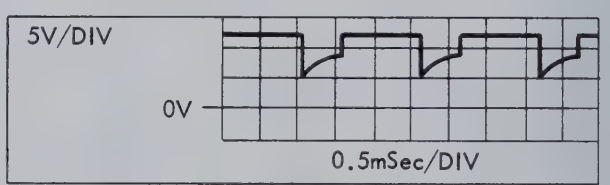


FIGURE 6-21

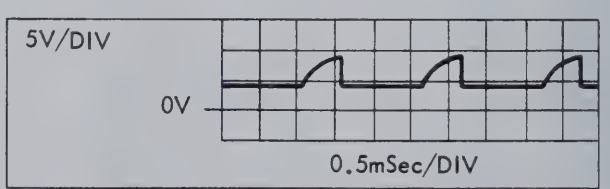
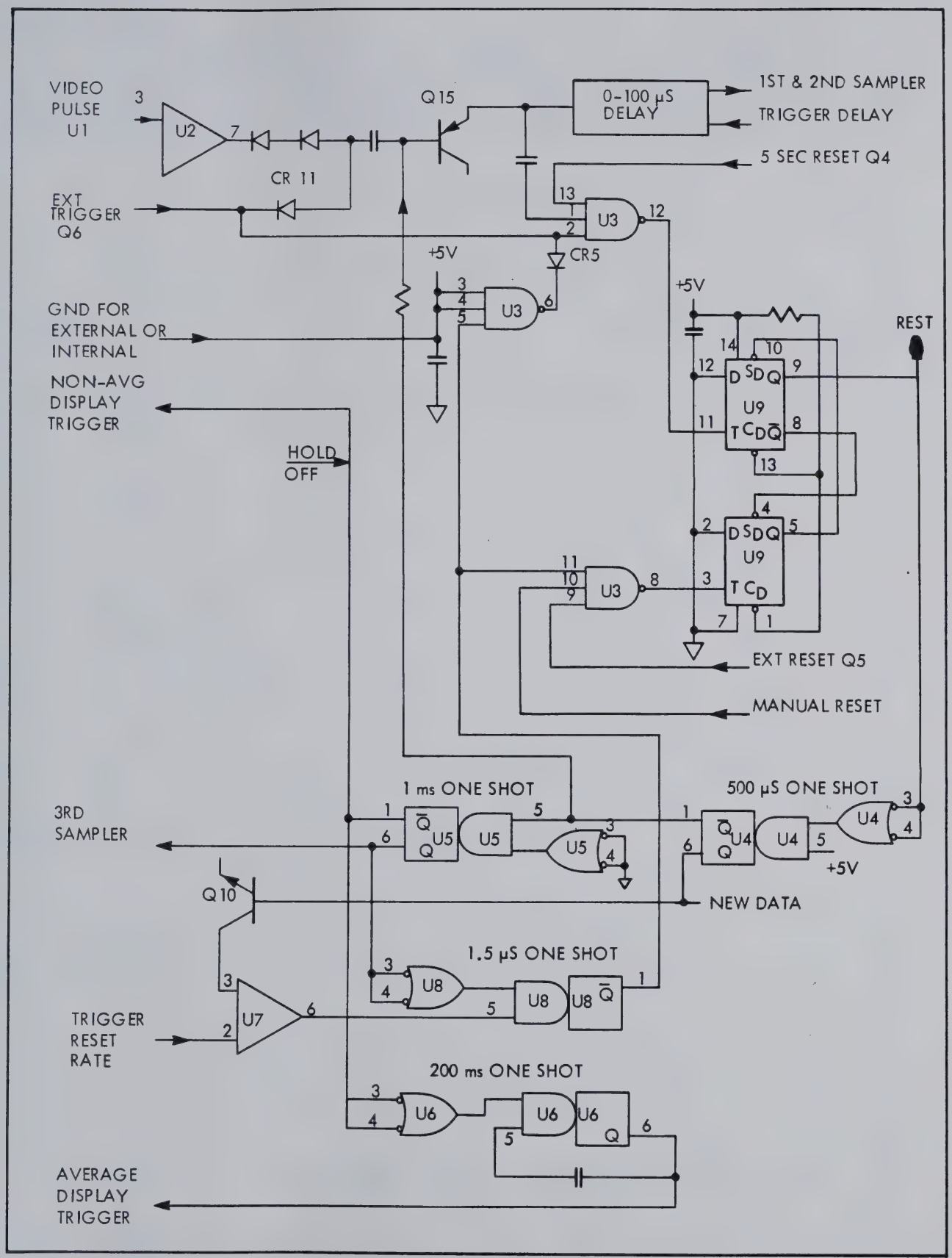
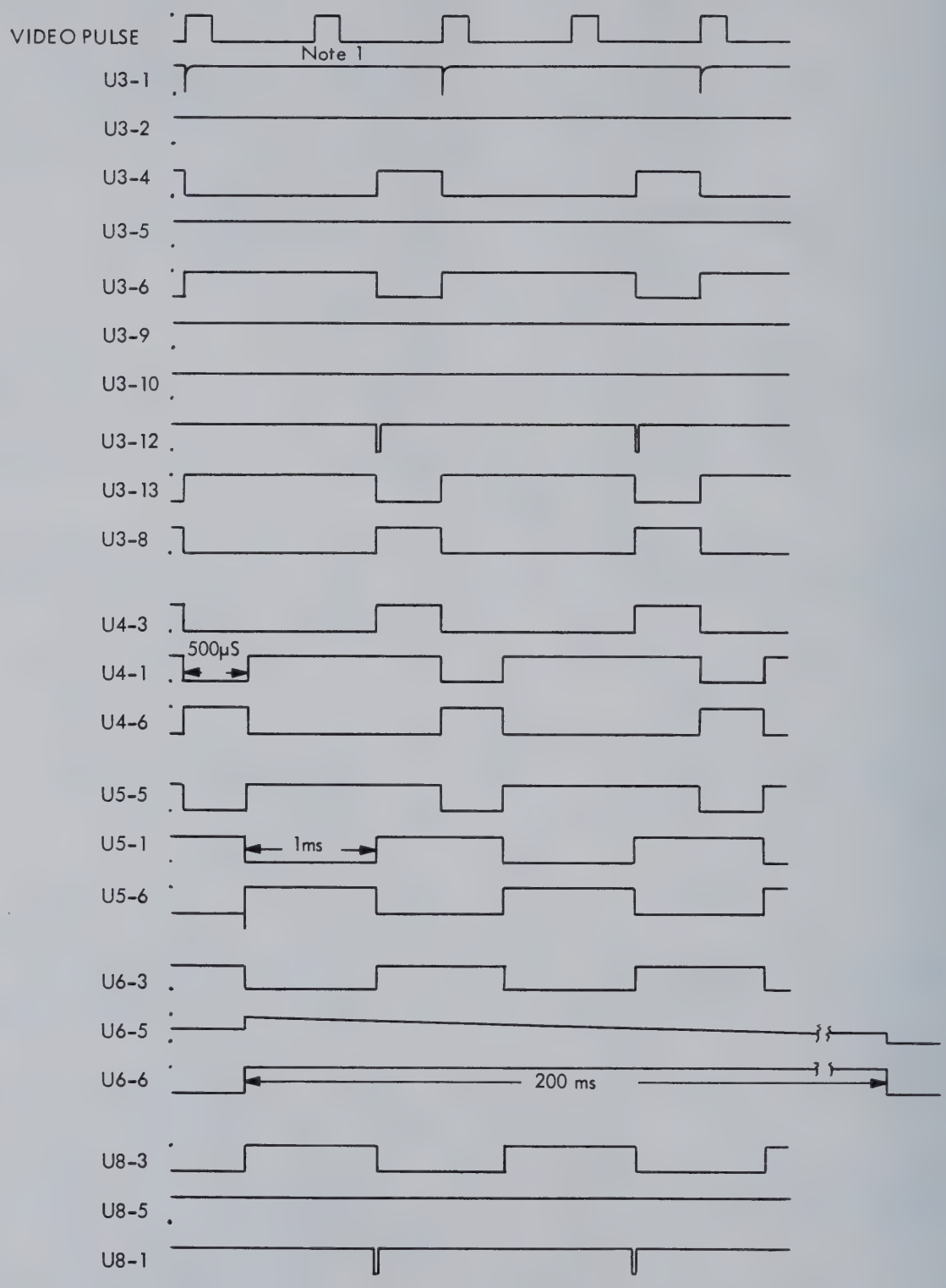


FIGURE 6-22



A6 TRIGGER CIRCUIT
FUNCTIONAL DIAGRAM
FIGURE 6-23



NOTE 1. Does not generate a trigger because of hold off from U5-1.

A6 TRIGGER CIRCUIT
TIMING DIAGRAM

FIGURE 6-24

A7 DIGITAL DISPLAY

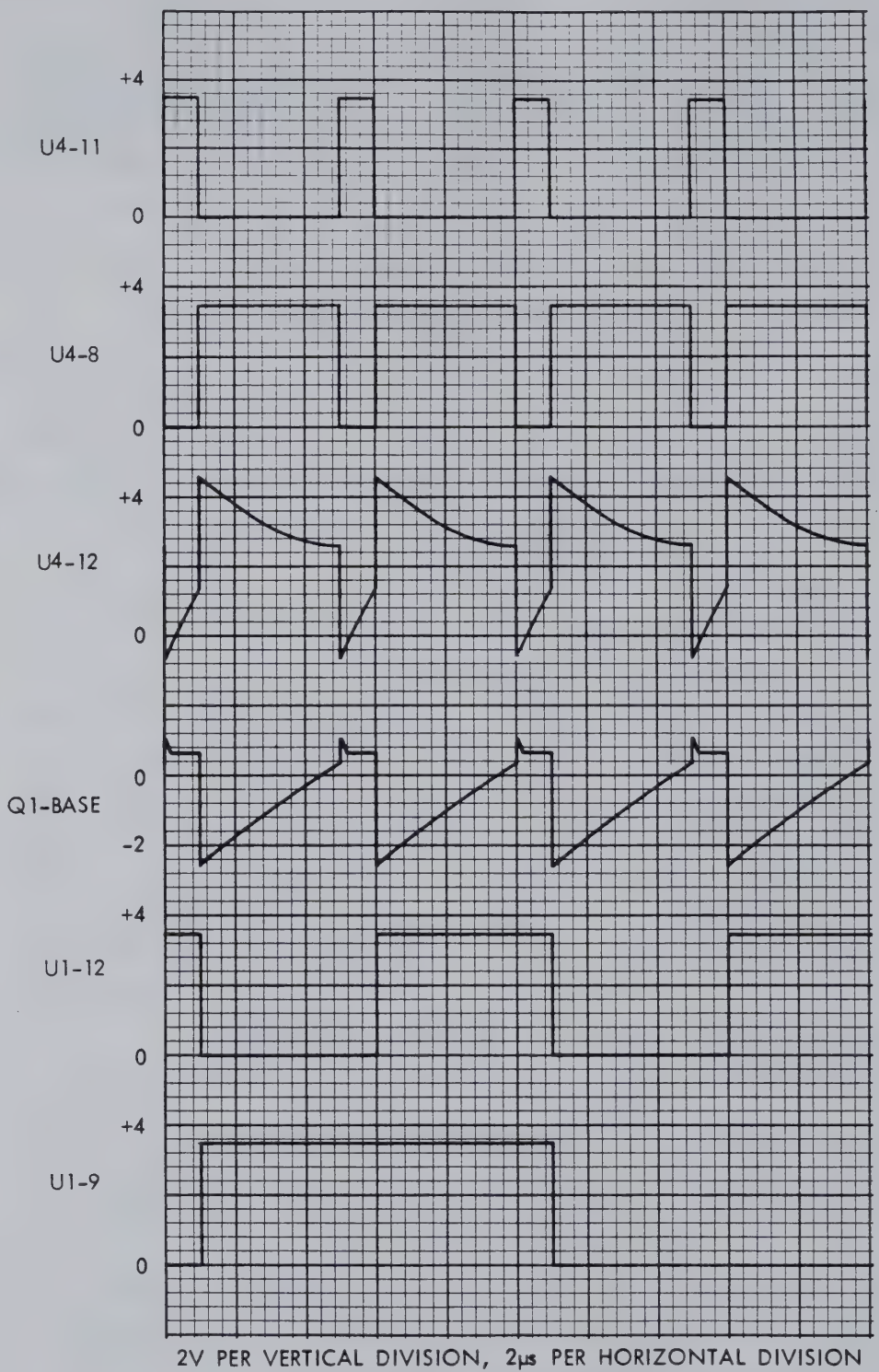
Voltage for the various pins of the integrated circuits used in the display are not given. Instead, timing diagrams and waveforms follow in Figures 6-25,6-26, and 6-27. You should first check that the oscillator is functioning as shown in Figure 6-25. If it is,then check to be sure that the state-decoder circuit is operating as shown in Figure 6-26. Finally, check the comparator circuit, as shown in Figure 6-27.

TABLE 6-1

CONTROL STATES FOR THE DIGITAL DISPLAY

STATE NUMBER		COUNT*	U3 INPUT CODE	LOGIC LOW AT U3 PIN
0	Trigger 1. Reset state counter to 0 2. Reset DCU's to 0.999 3. Start clock	-		
1	Wait.	0-3	100	5
2	Drive T Inputs of U6 Low.	4-7	100	5 & U4-6
3	Count Over-range 1, Store Polarity Data.	8	100	5
4	Reset 1st DCU to 0.	9	000	1
5	Count 1st Decade.	10-18	101	6
6	Reset 2nd DUC to 0.	19	001	2
7	Count 2nd Decade.	20-28	110	7
8	Reset 3rd DCU to 0.	29	010	3
9	Count 3rd Decade.	30-38	111	9
10	Stop Count and Wait.	39	011	4

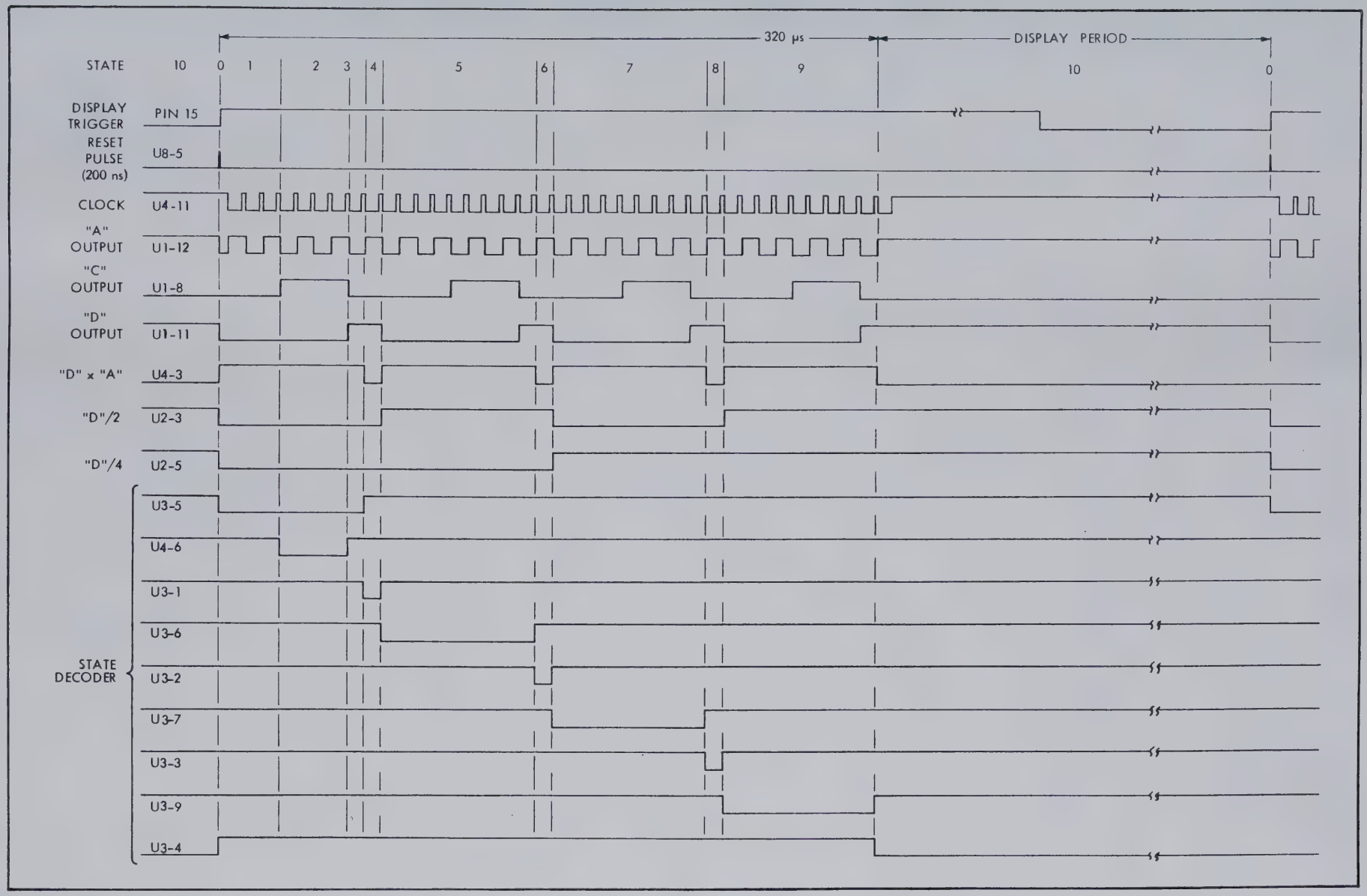
*The number in the "COUNT" column refers to the number of the negative transitions of the clock (A7U4-11).



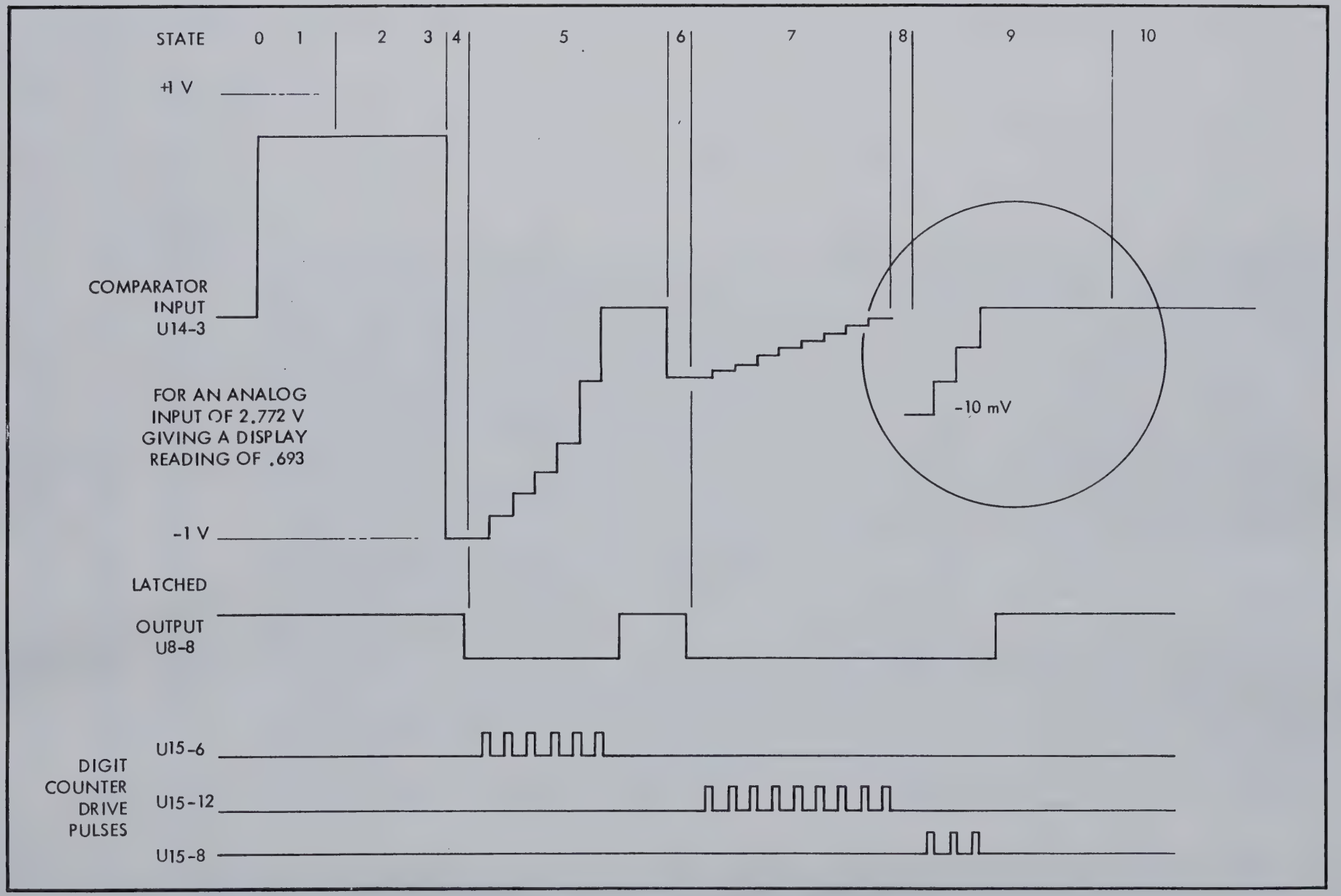
NOTE: These waveforms will be present for approximately 300 μs after the display is triggered. The first few cycles of the oscillation immediately following the trigger will be somewhat distorted.

OSCILLATOR CIRCUIT WAVEFORMS

FIGURE 6-25



TIMING DIAGRAM
FIGURE 6-26



COMPARATOR CIRCUIT INPUT VOLTAGE & OUTPUT TIMING DIAGRAM

FIGURE 6-27

A8 CALIBRATOR (Assembly 13694)

DEVICE	EMITTER	BASE	COLLECTOR	COMMENT
A8Q1	-0.43	0	+12.25	CALIBRATOR
A8Q2	+10.4	+12.6	-12.6	Switch set to +10dBm/10mW
A8Q3	+10.4	+9.7	+4.8	

PIN	2	3	4	5	6	7
A8U1	0	0	-12.5	-	0 ± 8	+12.5

A9 DETECTOR AMPLIFIER (Assembly 12125)

DEVICE	EMITTER	BASE	COLLECTOR	COMMENT
A9Q3	+10	+9.4	-6	
A9Q4	+10	+9.4	-6	
A9Q5	-6.6	-6	+12.6	
A9Q6	-6.6	-6	-0.6	
A9Q7	-0.6	0	+5.2	
A9Q8	+4.6	+5.2	+12.6	
A9Q9	+4	+4.6	+12.6	
	Drain Pin 1	Source Pin 2	Gate Pin 3	
A9Q1	+9.4	+1.4	0	TP91
A9Q2	+9.4	+1.4	0	

NOTICE

In this Model 1018B Operating and Maintenance Manual, the schematic diagrams are incorporated into the REPLACEABLE PARTS LISTING section.

Please go to page 7-1 of the REPLACEABLE PARTS LISTING (the next section) for the index of schematic diagram locations.

Thank You

SECTION 7

PARTS LIST AND SCHEMATIC DIAGRAMS

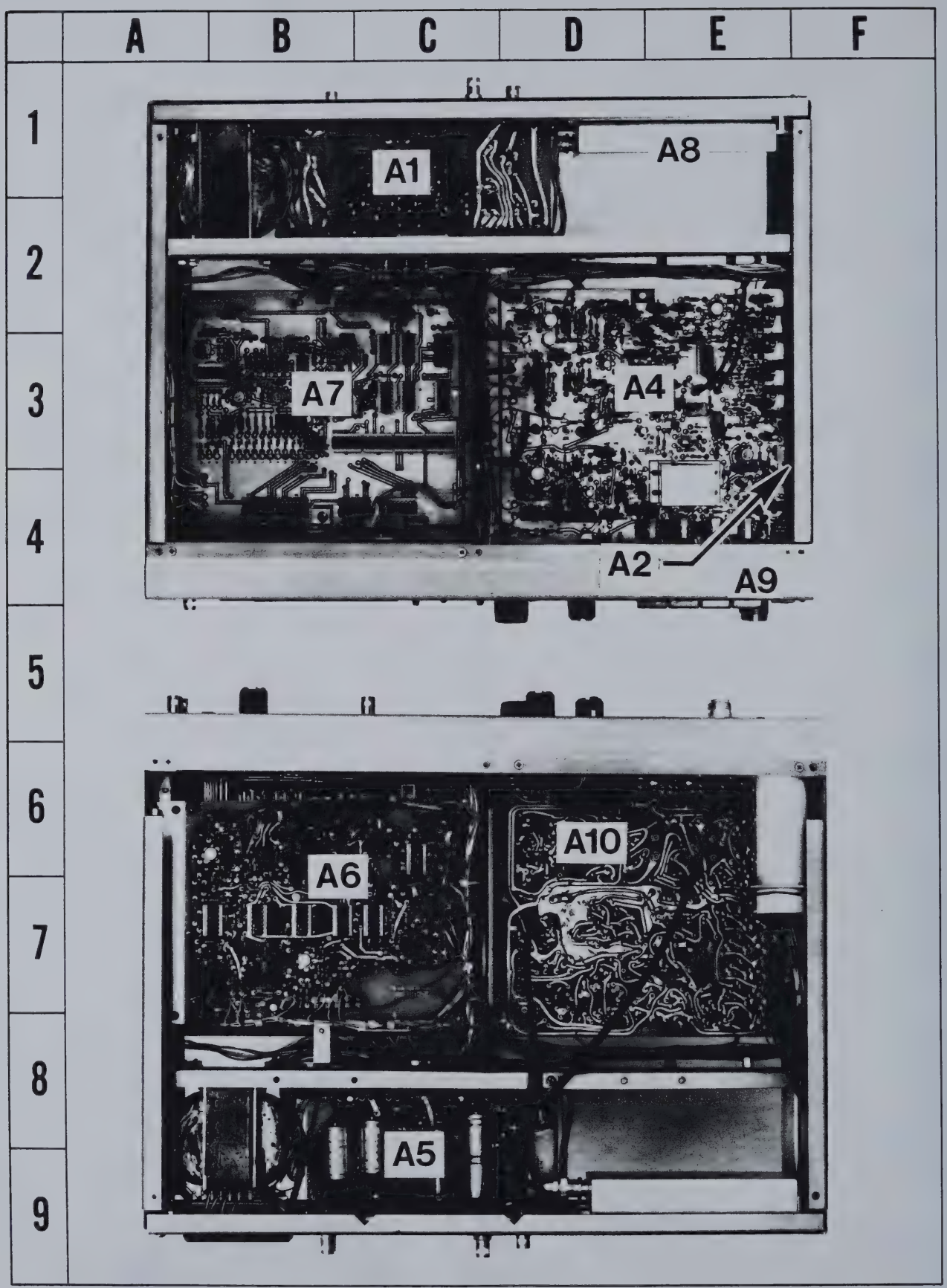
This section contains the illustrated parts list and the schematic diagrams of the assemblies which make up the Model 1018 B. The assemblies are identified by a reference designation with the letter "A" followed by a number (e.g., A1, A2, etc.).

Each assembly is provided with its parts list, component locating illustration and schematic diagram.

All electrical components are identified in the parts list and are indexed to the illustration by a location code referenced to a grid system.

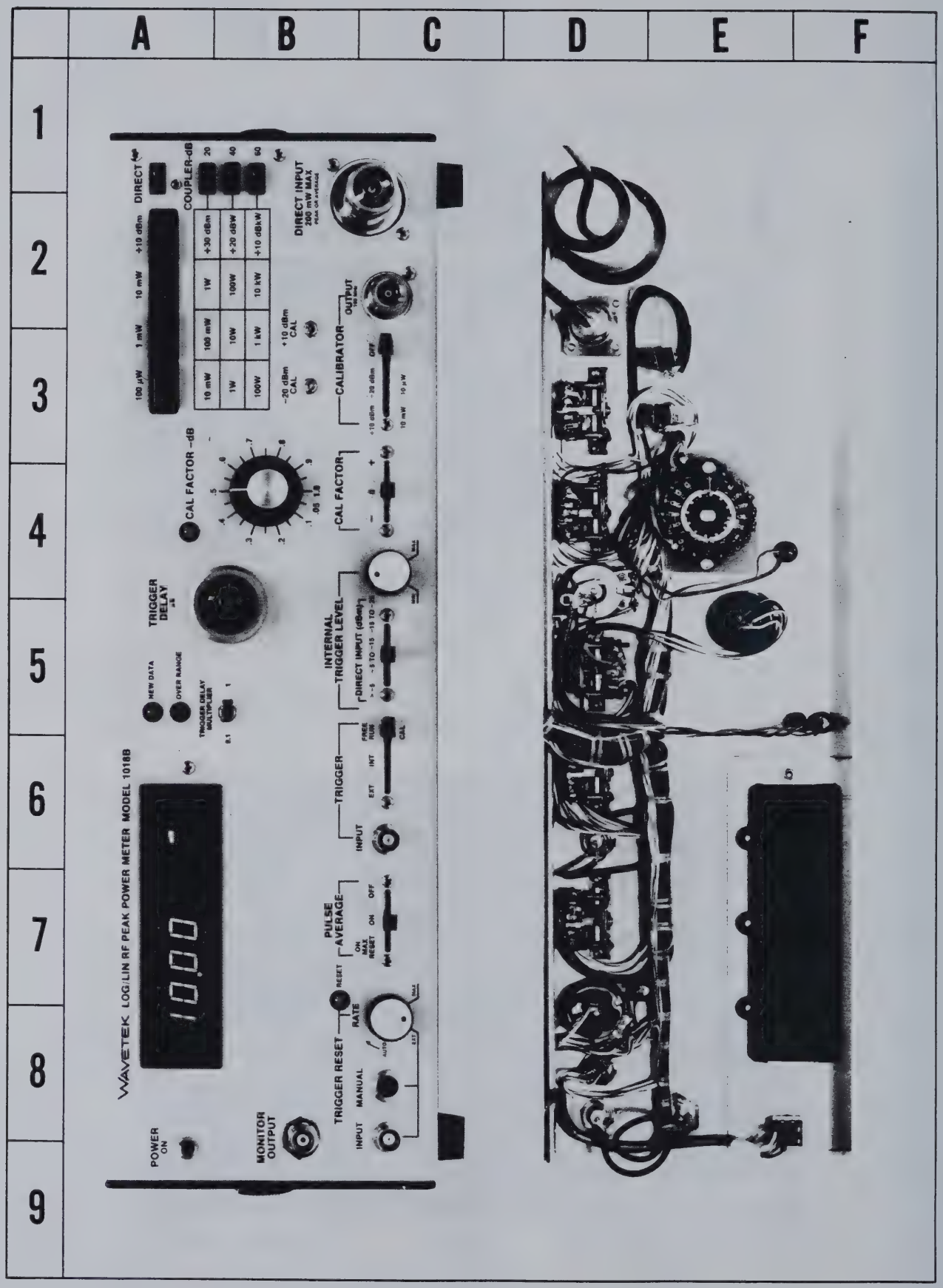
The Replaceable Parts List cross-referencing the Wavetek Microwave's part numbers to the original manufacturers' part numbers and the abbreviated list of Federal Supply Codes are included at the rear of this section.

		Page No.	Assembly	Schematic Diagram
-	LOG/LIN R.F. PEAK POWER METER	7-3	13468	13591
-	FRONT PANEL	7-5	13511	13591
-	ANUNCIATOR	7-5	13424	13591
A1	± 12.6V POWER SUPPLY	7-7	10121	10420
A2	RANGE SWITCH	7-9	13530	13531
A4	INPUT CIRCUIT	7-13	13525	13526
A5	RECTIFIER CIRCUIT & dB OFFSET	7-21	13546	13591
A6	TRIGGER CIRCUIT	7-23	13522	13523
A7	DIGITAL DISPLAY	7-29	13342	13343
A8	CALIBRATOR OSCILLATOR AND ATTENUATOR	7-33	13694	13670
A9	DETECTOR ASSEMBLY REPLACEMENT KIT	7-37	14902	14077
A10	CALIBRATOR FACTOR SWITCH	7-41	12088	12089
-	PARTS NUMBER/CROSS REFERENCE	7-47		
-	FEDERAL SUPPLY CODE FOR MANUFACTURERS	7-51		



LOG/LIN RF PEAK POWER METER
FIGURE 7-1

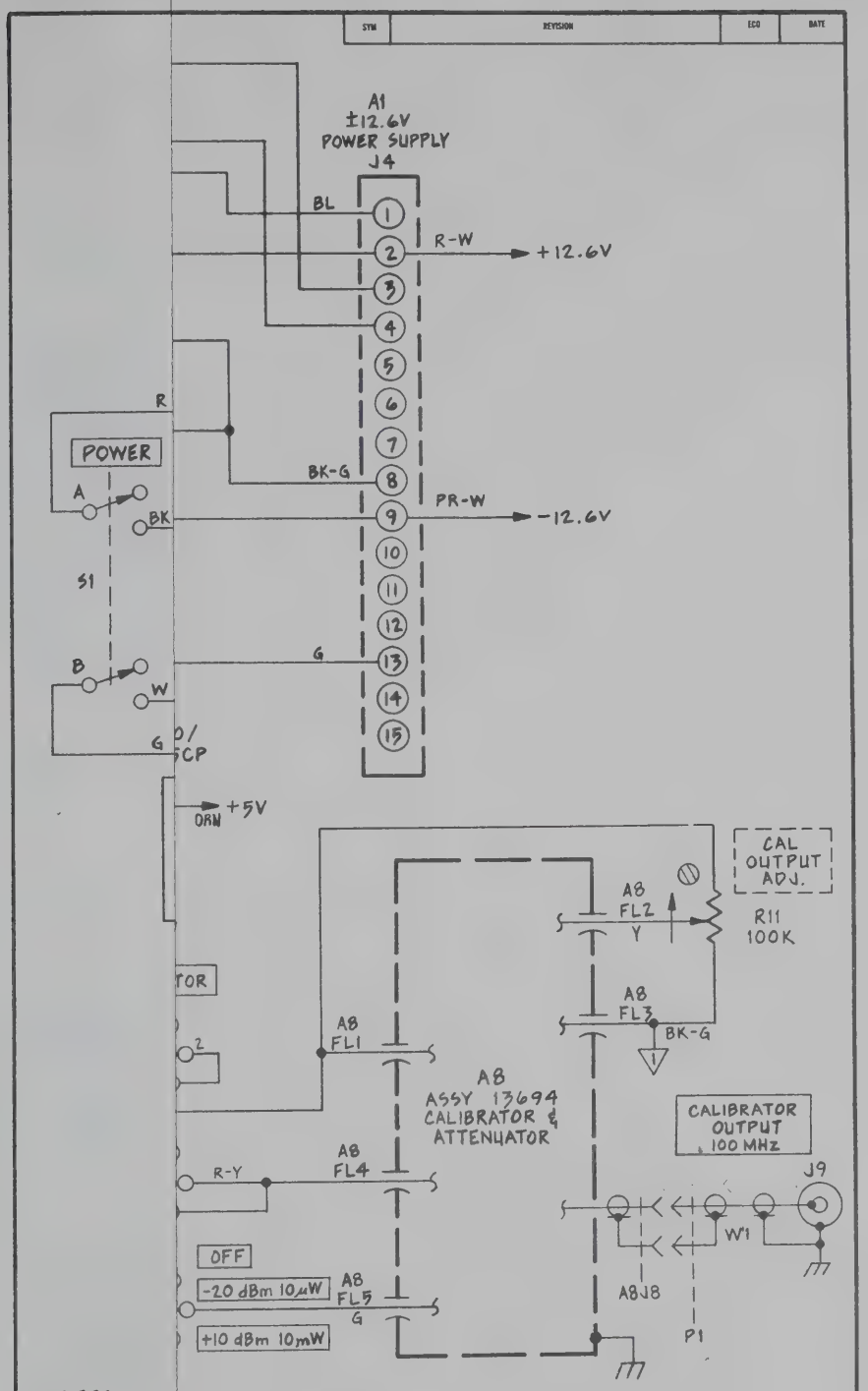
REPLACEABLE PARTS LIST				
REF. DESIG.	LOCATION	DESCRIPTION	PM PART NO.	TOT. QTY.
		LOG/LIN RF PEAK POWER METER - 13468 (Refer to Fig. 7-1)		
-	C-5	Front Panel Assy	13511	1
-	*	Annunciator PC Board Assy	13424	1
A1	C-1	Power Supply PC Board Assy	10121	1
A2	E-4	Range Switch PC Board Assy	13530	1
A4	E-3	Input Circuit PC Board Assy	13525	1
A5	C-8	Rectifier & dB Offset PC Board Assy	13546	1
A6	B-7	Trigger Circuit PC Board Assy	13522	1
A7	B-3	3 Digit Display PC Board Assy	13342	1
A8	E-1	Calibrator Oscillator and Attenuator Assy	13694	1
A9	*	Power Detector Amplifier Assy	13664	1
A10	D-6	Cal Factor Switch Assy	12088	1
A11	F-7	Display Readout PC Board Assy	13345	
C2	E-8	Cap, Tantalum 0.47µF 15V	10787-8	1
C3		Cap, Cer. .001µF 1000V	10000-4	
F1	B-9	Fuse, 3AG, 1.0A, 250V, Slo-Blow	10064-9	1
J1	B-9	AC Receptacle, 3 Pin w/Voltage Select	16364	1
J4	D-1	Connector 15 contact	10050-1	1
J5	D-2	Connector, BNC Jack	10048	1
J7	D-9	Connector, BNC Jack	11504	1
J8	D-9	Connector, BNC Jack Insulated	11689	1
J9	C-9	Connector, BNC Jack	10048	
Q1	C-8	Transistor, RCA 40250	10020	2
Q2	C-8	Transistor, RCA 40250	10020	Ref
R11	*	Resistor, Var. 100KΩ	11688-1	1
T1	B-8	Transformer, Power	13447	1
U1	D-2	IC, Voltage Reg MC7805CP	13479-1	1
W1	D-2	Cable Assembly, Cal Out	13817	1
	*	Power Cord	12356	1
	*	Top Cover	10325	1
	*	Bottom Cover	13559	1
	*	Bail	10811	1
		* Not Illustrated		



FRONT PANEL ASSEMBLY
FIGURE 7-2

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PART NO.	TOT. QTY.
		FRONT PANEL ASSEMBLY - 13511 (Refer to Fig. 7-2)		
C1	D-8	Cap, cer. .01μF 20% 100V	10000-11	1
CR6	A-5	LED, Yellow MV5352	13550	3
CR7	C-7	LED, Yellow MV5352	13550	Ref
CR8	B-4	LED, Yellow MV5352	13550	Ref
CR9	A-5	LED, Red MV5025	12389	1
J2	E-8	Connector, BNC Jack	11504	1
J3	D-6	Connector, BNC Jack	10048	2
J6	D-8	Connector, BNC Jack	10048	Ref
R1	E-3	Res, var. 100KΩ 20% 25 turns	11688-1	2
R3	E-3	Res, var. 100KΩ 20% 25 turns	11688-1	Ref
R4	D-5	Res, car flm, 4.7KΩ 5% 1/4W	10013-33	1
R5	D-5	Res, car flm 470Ω 5% 1/4W	10013-21	1
R6	D-5	Res, car flm 100Ω 5% 1/4W	10013-13	2
R7	D-5	Res, var. 1.5KΩ 20% 1/2W	10095-3	1
R8	D-5	Res, car flm 100Ω 5% 1/4W	10013-13	Ref
R9	E-5	Potentiometer, WW, 5KΩ 10 Turn with Dial	12497-1	1
R10	D-8	Res, var 10KΩ 20% 1/2W with switch	12647	1
S1	F-9	Switch, Toggle, DPDT	10057	1
S3	D-5	Switch, Lever, 5P3T	10450	5
S4	D-6	Switch, Lever, 5P3T	10450	Ref
S5	D-8	Switch, Pushbutton, SPDT	10058	1
S6	D-3	Switch, Lever, 5P3T	10450	Ref
S7	D-4	Switch, Lever, 5P3T	10450	Ref
S9	D-7	Switch, Lever, 5P3T	10450	Ref
	A-3	Knob, Pushbutton	11536	4
	A-7	Bezel	13516-1	1
	A-7	Filter	13549	1
	B-2	Knob, Pushbutton	11683	4
	B-4	Knob, Panel	10804-1	1
	C-8	Knob, Panel	10803-1	2
		ANNUNCIATOR PC BOARD ASSEMBLY - 13424 (Refer to Fig. 7-2)		
CR1	A-7	Display, Orange	13457	5
CR2	A-7	Display, Orange	13457	Ref
CR3	A-7	Display, Orange	13457	Ref
CR4	A-7	Display, Orange	13457	Ref
CR5	A-7	Display, Orange	13457	Ref



NOTES:

1. +5V WIRED
   +5V COMM
   +12.6V WI
   -12.6V WI
   ▽1 SIGNAL
   ▽2 SYSTE
   ▽3 LOGIC
2. SWITCH S
   METER R
3. UNLESS O
   TOR VALU
   ±5% 1/4 W
   IN MICROF

DESCRIPTION	DATE
AL	2-9-77
	7-7-77

NEXT ASSY

ECO-A 446
1016
1017
H1291

PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA

LOG/LIN RF PEAK POWER METER

DRAWING NO. 13591 REV J

SHEET 1 OF 2

SYM	REVISION	ECO	DATE

J1
F1 1.0A
100V 120V 220V 240V
POWER
S1
R L A BK B W J G N
BR-W 20V BR-Y 100V Y-W O-W 120V GY-W
C A E D F
1 3 4 2 5

T1
10 G-W
9.7V
11 G-W
8 BL-W 1
14.9V
9 BL-W 3
6 W 5
14.9V
7 W 7
14 Y-W 10
150V
15 Y-W 11
16 O-W 14
8.2V
17 BK-W 13
8.2V
18 O-W 15
12
6.3V
13
19
8.7V
20

A5
ASSY 13546
RECTIFIER & dB OFFSET
CR2 CR1 CR4 CR3 IN4383
CR6 CR5 CR8 CR7 IN4383
CR10 CR9 CR12 CR11 IN4385
CR15 IN 5276B
CR13 IN4383
CR14 IN4383
C1 1000
C2 1000
C3 20
C4 4000
C5 .22
C6 5.0
R1 100
R2 10K
R3 1K
R4 100K
R5 470K
R8 3.48K 1%
R9 500
R10 2.00K 1%
R11 3.3K
CR21 IN4148
Q1 2N5833
Q4 2N3565
dB OFFSET
2 R-G
4 BK-W
6 BL
8 PR-W
9 R A4-1 +150V
17 W
16
28 BK-G
24 BL A2-30
25 PR-W -12.6V
27 BK-G A2-5
26 BK-O S9

Q1 40250
Q2 40250

A1
±12.6V
POWER SUPPLY
J4
BL 1
2 R-W +12.6V
3
4
5
6
7
BK-G 8
9 PR-W -12.6V
10
11
12
G 13
14
15

U1
LM340/
MC7805CP
3 (C) 2 (E) +5V
1 (B)
C2 .47
CALIBRATOR
A 1 2 3
B R-Y
D OFF
-20 dBm 10μW
+10 dBm 10mW
-12.6V S6
+12.6V
AB FL1
AB FL4
AB FL5
G
AB
ASSY 13694
CALIBRATOR & ATTENUATOR
AB FL2
AB FL3
BK-G
CAL OUTPUT ADJ.
R11 100K
CALIBRATOR OUTPUT 100 MHz
J9
W1
AB J8
P1
TB2

NOTES:

1. +5V WIRED TO TB4 PIN 4.
   +5V COMMON WIRED TO TB4 PIN 3.
   +12.6V WIRED TO TB3 PINS 3 & 4.
   -12.6V WIRED TO TB3 PINS 1 & 2.
   ▽ SIGNAL GND (WIRED TO A4-44).
   ▽ SYSTEM GND BUSS (WIRED TO TB2).
   ▽ LOGIC GND (WIRED TO U1-3).
2. SWITCH S10 IS PART OF POTENTIOMETER R10.
3. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS AND ARE ±5% 1/4 WATT. CAPACITOR VALUES ARE IN MICROFARADS.

EXAMPLE: S3, S4, S6, S7, S9

TOP VIEW
PIN CONFIGURATION TYP.
BOTTOM VIEW

ECO-A 446 1016 1017 H1291

ITEM	REQD	PART NO	DESCRIPTION	NEXT ASSY
			LIST OF MATERIAL	

FINISH OR TREATMENT
UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE .XX ± .015 .XXX ± .005
SCALE

		DATE
DRAWN	J.S.	2-9-77
ENG	RB	7-7-77
PROD		

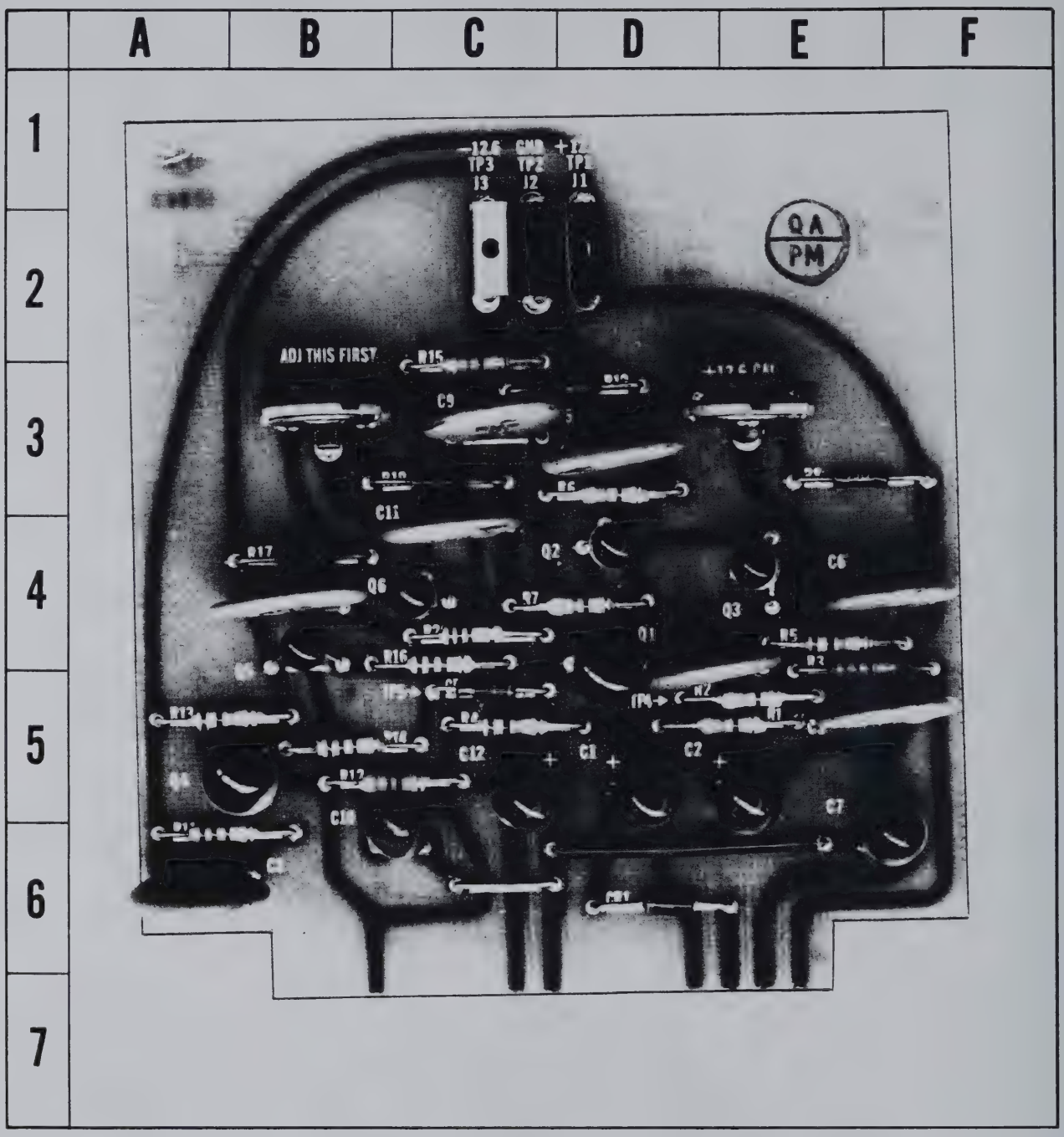
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA

LOG/LIN RF PEAK POWER METER

DRAWING NO. 13591 REV J
SHEET 1 OF 2

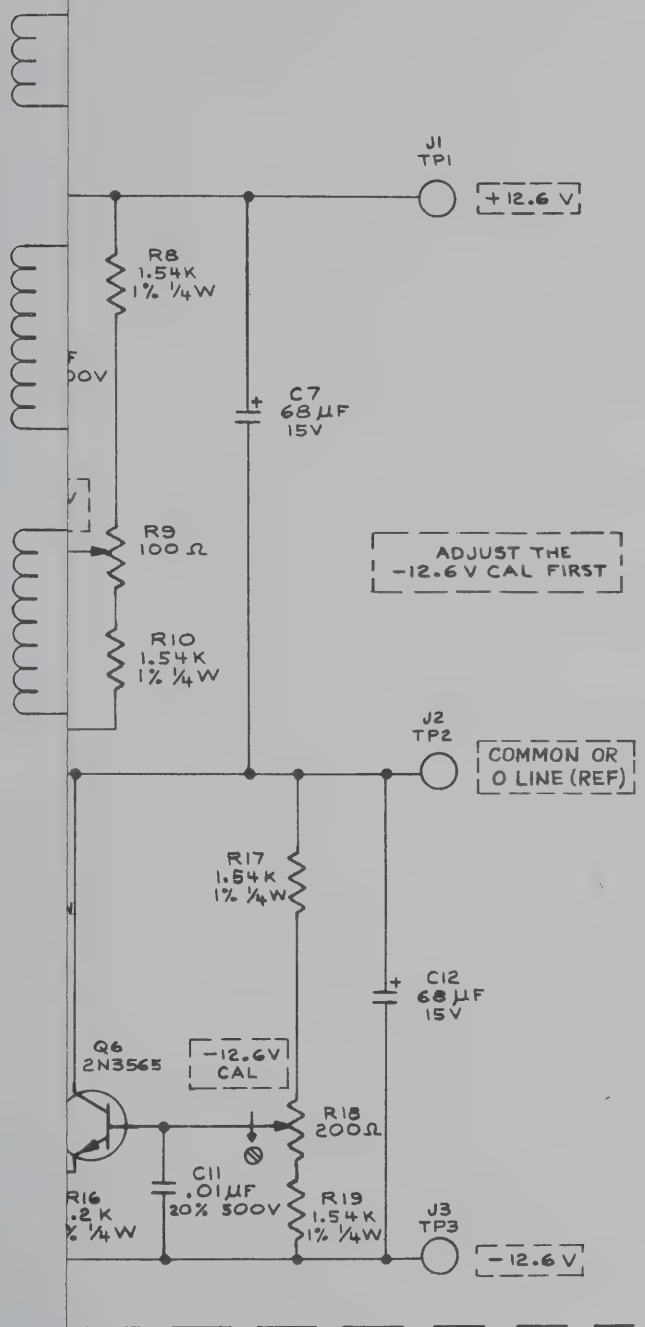
REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PM PART NO.	TOT. QTY.
		POWER SUPPLY PC BOARD ASSEMBLY - 10121 (Refer to Fig. 7-3)		
A1C1	D-5	Cap, Ta, 68 µF 20% 15 V	10787-4	5
A1C2	E-5	Cap, Ta, 68 µF 20% 15 V	10787-4	Ref
A1C3	E-5	Cap, cer, .01 µF 20% 500 V	10000-7	7
A1C4	D-5	Cap, cer, .01 µF 20% 500 V	10000-7	Ref
A1C5	D-3	Cap, cer, .01 µF 20% 500 V	10000-7	Ref
A1C6	E-4	Cap, cer, .01 µF 20% 500 V	10000-7	Ref
A1C7	E-6	Cap, Ta, 68 µF 20% 15 V	10787-4	Ref
A1C8	A-6	Cap, cer, .01 µF 20% 500 V	10000-7	Ref
A1C9	C-3	Cap, cer, .01 µF 20% 500 V	10000-7	Ref
A1C10	C-6	Cap, Ta, 68 µF 20% 15 V	10787-4	Ref
A1C11	C-4	Cap, cer, .01 µF 20% 500 V	10000-7	Ref
A1C12	C-5	Cap, Ta, 68 µF 20% 15 V	10787-4	Ref
A1C12	B-4	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	1
A1CR1	D-6	Diode, 1N4383	10044-1	1
A1CR2	C-5	Diode, 1N823	10045	1
A1J1	D-2	Test Jack, Red	10054-2	1
A1J2	C-2	Test Jack, Black	10054-1	1
A1J3	C-2	Test Jack, Blue	10054-3	1
A1Q1	D-5	Transistor, 2N3569	10017	2
A1Q2	D-4	Transistor, 2N3565	10019	4
A1Q3	E-4	Transistor, 2N3565	10019	Ref
A1Q4	A-5	Transistor, 2N3569	10017	Ref
A1Q5	B-4	Transistor, 2N3565	10019	Ref
A1Q6	C-4	Transistor, 2N3565	10019	Ref
A1R1	E-5	Res, car flm, 470 Ω 5% 1/4 W	10013-21	4
A1R2	E-5	Res, car flm, 470 Ω 5% 1/4 W	10013-21	Ref
A1R3	E-5	Res, car flm, 220 Ω 5% 1/4 W	10013-17	3
A1R4	C-5	Res, car flm, 10 KΩ 5% 1/4 W	10013-37	3
A1R5	E-4	Res, car flm, 10 KΩ 5% 1/4 W	10013-37	Ref
A1R6	D-3	Res, car flm, 470 Ω 5% 1/4 W	10013-21	Ref
A1R7	C-4	Res, car flm, 4.7 KΩ 5% 1/4 W	10013-33	2
A1R8	E-3	Res, met flm, 1.54 KΩ 1% 1/8 W	10015-1	4
A1R9	E-3	Res, var comp, 100 Ω 20% 1/4 W	10046-9	1
A1R10	D-3	Res, met flm, 1.54 KΩ 1% 1/8 W	10015-1	Ref
A1R11	A-5	Res, car flm, 220 Ω 5% 1/4 W	10013-17	Ref
A1R12	B-5	Res, car flm, 4.7 KΩ 5% 1/4 W	10013-33	Ref
A1R13	A-5	Res, car flm, 10 KΩ 5% 1/4 W	10013-37	Ref
A1R14	B-5	Res, car flm, 220 Ω 5% 1/4 W	10013-17	Ref
A1R15	C-2	Res, car flm, 470 Ω 5% 1/4 W	10013-21	Ref
A1R16	C-4	Res, car flm, 2.2 KΩ 5% 1/4 W	10013-29	1
A1R17	B-4	Res, met flm, 1.54 KΩ 1% 1/8 W	10015-1	Ref
A1R18	B-3	Res, var comp, 200 Ω 20% 1/4 W	10046-6	1
A1R19	C-3	Res, met flm, 1.54 KΩ 1% 1/8 W	10015-1	Ref
A1R20	C-4	Res, car flm, 100 Ω 5% 1/4 W	10013-13	1



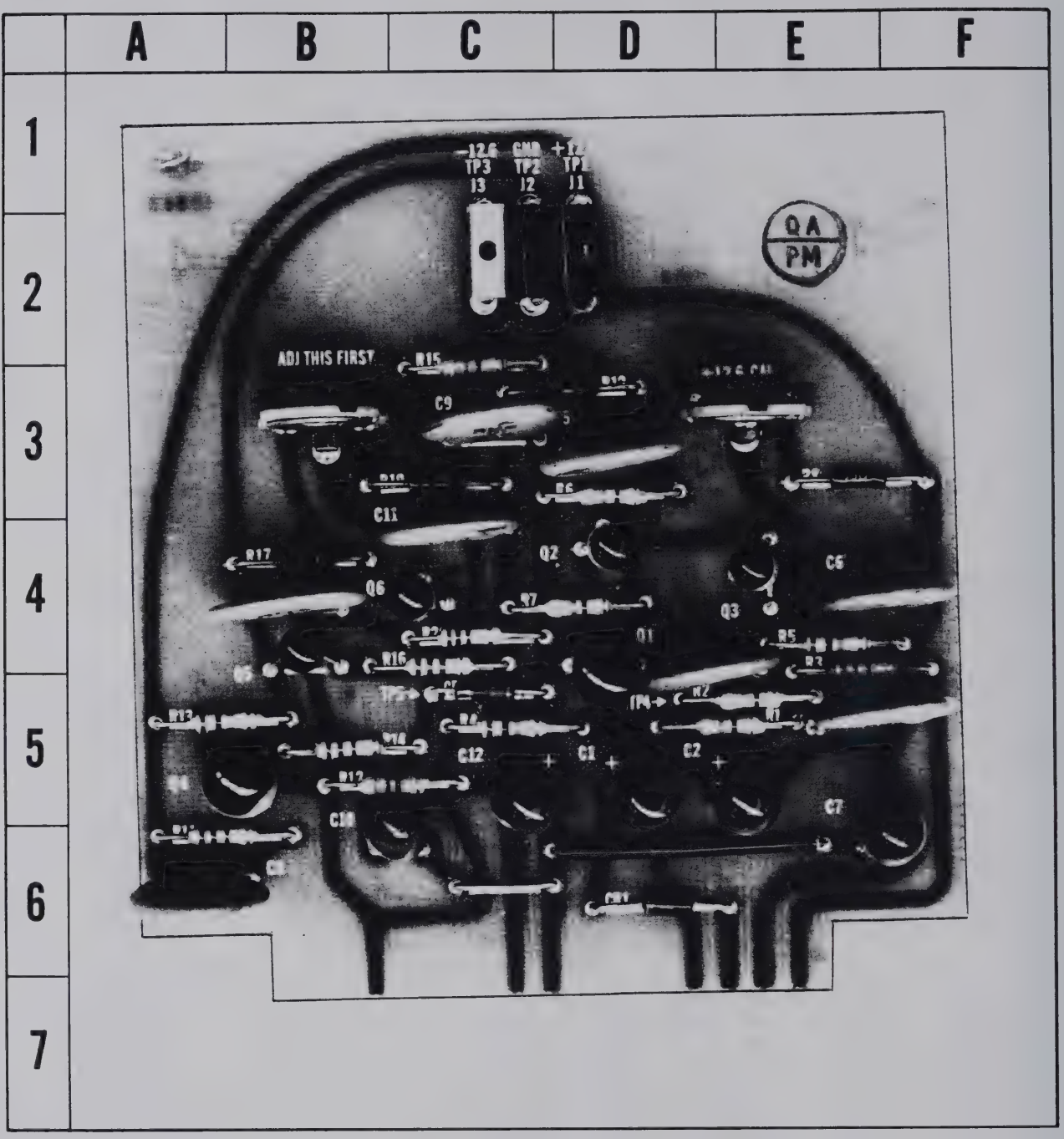
±12.6V POWER SUPPLY BOARD ASSEMBLY
FIGURE 7-3

ASSEMBLY 10121
ENCE DESIGNATORS ARE ABBREVIATED
PREFIX WITH A1 OR A2



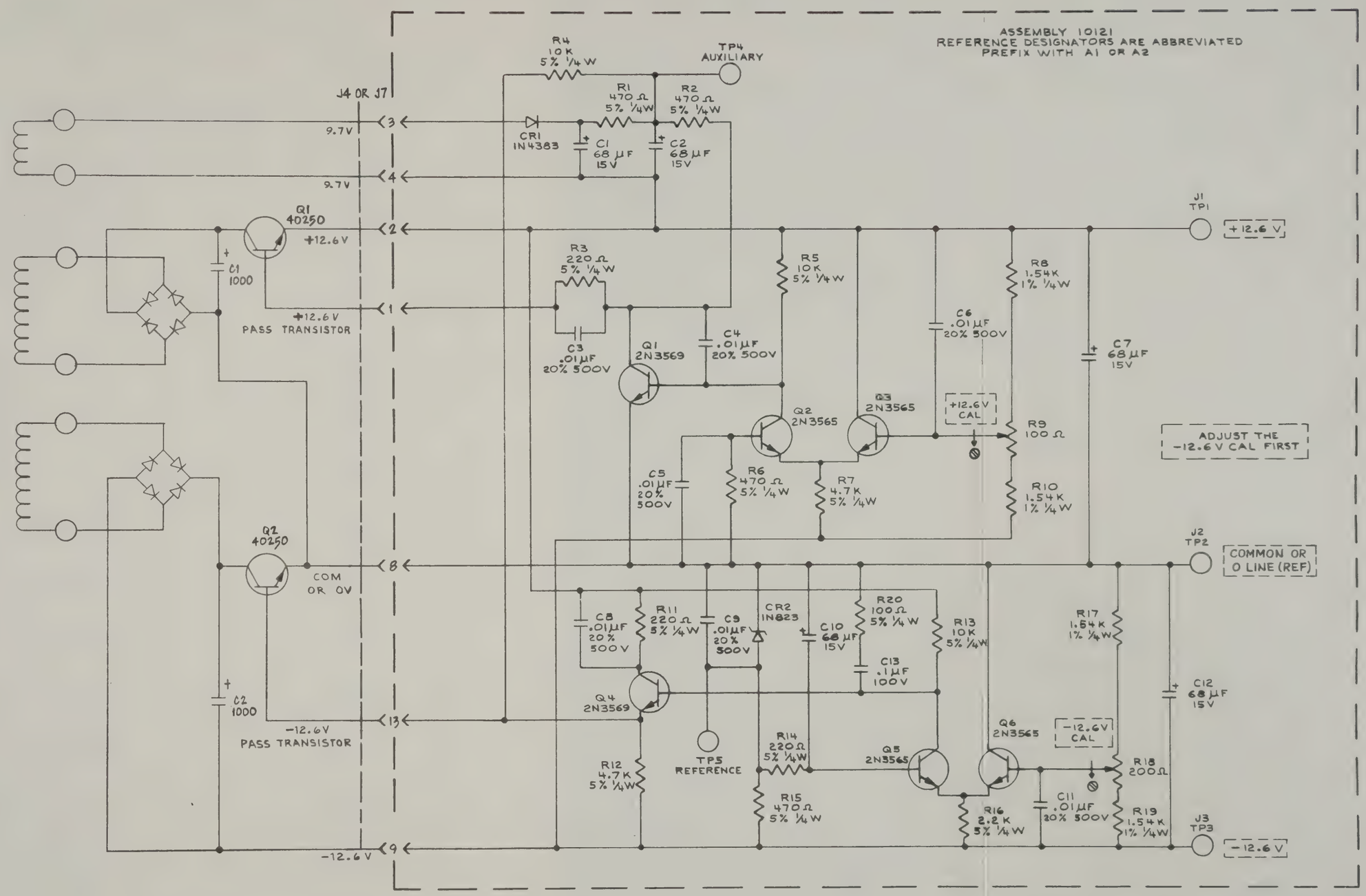
PACIFIC MEASUREMENTS		
SCALE: ——	APPROVED BY: Han A. Anderson	DRAWN BY AHO
DATE: 1-11-67		REVISED
±12.6 VOLT POWER SUPPLY	DRAWING NUMBER 10420	REV D

17X22 PRINTED ON NO



±12.6V POWER SUPPLY BOARD ASSEMBLY
FIGURE 7-3

ASSEMBLY 10121
REFERENCE DESIGNATORS ARE ABBREVIATED
PREFIX WITH A1 OR A2



NOTE:
REFERENCE DESIGNATOR "J7" AND REFERENCE DESIGNATOR PREFIX "A2" ARE ONLY USED ON MODEL 1003 AND 1004.

PACIFIC MEASUREMENTS			
SCALE: ——	APPROVED BY: Alan N. Anderson	DRAWN BY AHO	
DATE: 1-11-67		REVISED	
±12.6 VOLT POWER SUPPLY		DRAWING NUMBER 10420	REV D

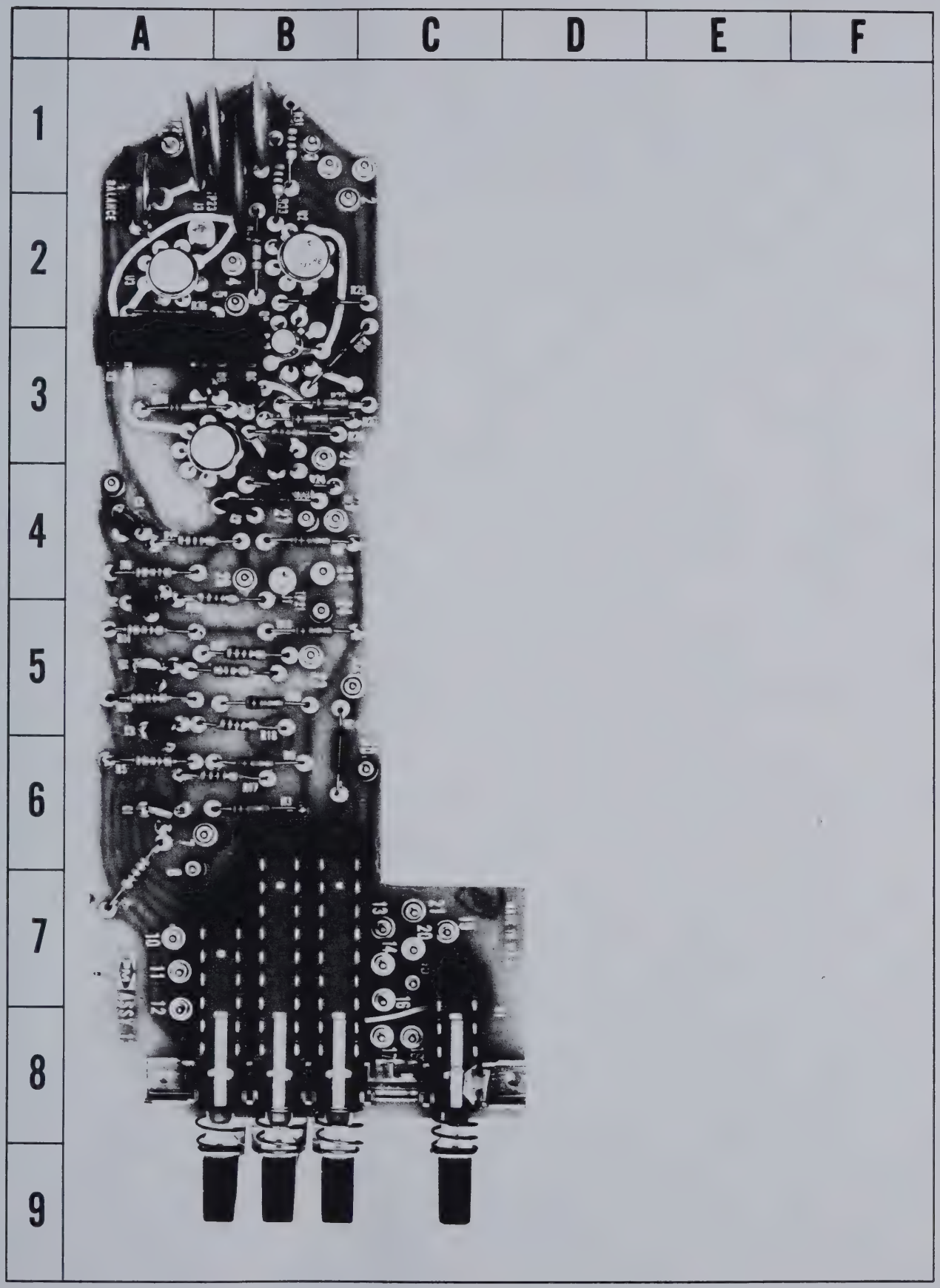
17288 PRINTED ON NO. 1000H CLEARPRINT

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PM PART NO.	TOT. QTY.
		RANGE SWITCH PC BOARD ASSEMBLY - 13530 (Refer to Fig. 7-4)		
A2C1	B-1	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	4
A2C2	B-1	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A2C3	A-3	Cap, mylar, 0.22 µF 10% 200 V	10007-8	1
A2C4	A-1	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A2C5	B-2	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A2C6	B-4	Cap, cer, .001 µF ±20% 1000 V	10000-4	1
A2J1	B-5	Test Jack, Yellow	10140-2	2
A2J2	A-1	Test Jack, Black	10140-3	1
A2J3	A-2	Test Jack, Yellow	10140-2	Ref
A2Q1	A-6	Transistor, 2N3644	10023	5
A2Q2	A-6	Transistor, 2N3644	10023	Ref
A2Q3	A-4	Transistor, 2N3644	10023	Ref
A2Q4	A-5	Transistor, 2N3644	10023	Ref
A2Q5	A-5	Transistor, 2N3644	10023	Ref
A2Q6	A-3	Transistor, E112	12591	1
A2Q7	B-4	Transistor, 2N4121	10398	1
A2Q8	B-3	Transistor, 2N3646	10018	1
A2Q9	B-3	Transistor, FM3955	11432	1
A2R1	B-6	Res, met flm, 63.00 KΩ 0.1% 1/8 W	11485-13	1
A2R2	A-7	Res, car flm, 3.3 KΩ 5% 1/4 W	10013-31	5
A2R3	B-6	Res, car flm, 10 KΩ 5% 1/4 W	10013-37	5
A2R4	-	Not Used		
A2R5	A-6	Res, car flm, 3.3 KΩ 5% 1/4 W	10013-31	Ref
A2R6	B-6	Res, car flm, 10 KΩ 5% 1/4 W	10013-37	Ref
A2R7	-	Not Used		
A2R8	A-4	Res, car flm, 3.3 KΩ 5% 1/4 W	10013-31	Ref
A2R9	B-4	Res, car flm, 10 KΩ 5% 1/4 W	10013-37	Ref
A2R10	-	Not Used		
A2R11	A-5	Res, car flm, 3.3 KΩ 5% 1/4 W	10013-31	Ref
A2R12	B-5	Res, car flm, 10 KΩ 5% 1/4 W	10013-37	Ref
A2R13	-	Not Used		
A2R14	A-5	Res, car flm, 3.3 KΩ 5% 1/4 W	10013-31	Ref
A2R15	B-5	Res, car flm, 10 KΩ 5% 1/4 W	10013-37	Ref
A2R16	-	Not Used		
A2R17	B-6	Res, car flm, 120Ω 5% 1/4 W	10013-14	5
A2R18	B-6	Res, car flm, 120Ω 5% 1/4 W	10013-14	Ref
A2R19	A-4	Res, car flm, 120Ω 5% 1/4 W	10013-14	Ref
A2R20	B-6	Res, car flm, 120Ω 5% 1/4 W	10013-14	Ref
A2R21	B-5	Res, car flm, 120Ω 5% 1/4 W	10013-14	Ref
A2R22	B-5	Res, car flm, 4.7 KΩ 5% 1/4 W	10013-33	1
A2R23	B-4	Res, met flm, 48.7 KΩ 1% 1/8 W	10015-41	1
A2R24	B-4	Res, met flm, 39.2 KΩ 1% 1/8 W	10015-61	1
A2R25	A-3	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	4
A2R26	B-3	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	Ref
A2R27	B-3	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	Ref
A2R28	B-3	Res, car flm, 22 KΩ 5% 1/4 W	10013-41	2
A2R29	B-2	Res, met flm, 61.9 KΩ 1% 1/8 W	10015-25	2
A2R30	B-3	Res, met flm, 61.9 KΩ 1% 1/8 W	10015-25	Ref
A2R31	B-1	Res, car flm, 100 Ω 5% 1/4 W	10013-13	2
A2R32	A-2	Res, var comp, 10 KΩ 20% 1/4 W	10046-8	1

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PM PART NO.	TOT. QTY.
A2R33	B-2	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A2R34	B-2	Res, car flm, 100 KΩ 5% 1/4W	10013-49	Ref
A2R35	A-2	Res, car blm, 22 KΩ 5% 1/4W	10013-41	Ref
A2S1	C-8	Switch, Pushbutton	12026	1
A2U1	A-4	IC, Voltage Follower	12395	2
A2U2	B-2	IC, Op Amp	11539	1
A2U3	A-2	IC, Voltage Follower	12395	Ref



RANGE SWITCH BOARD ASSEMBLY
FIGURE 7-4

Wavetek Microwave,Inc.
488 Tasman Drive, Sunnyvale, California 94089
Tel: (408)734-5780 TWX:910-339-9273 FAX: 408-747-1265

CERTIFICATE OF CALIBRATION

CERTIFICATE NO. 04129

ITEM LOG/LIN RF PEAK POWER METER

MODEL NO. 1018B SERIAL NO. 1817684 CODE NO. 27

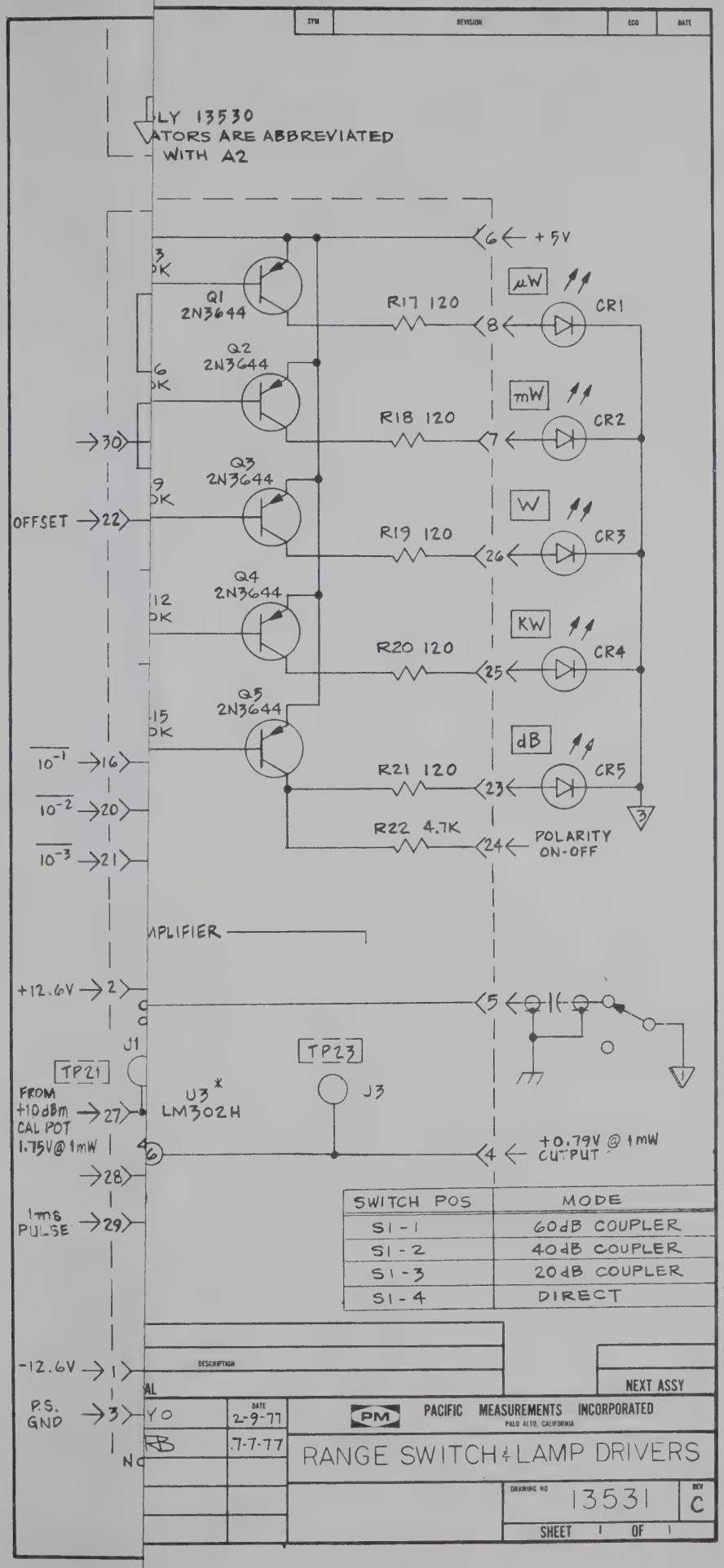
CALIBRATION TEMPERATURE (°C) 23 HUMIDITY (%) 66

LIST OF CALIBRATION STANDARDS							
MFGR.	MODEL NO	PAN NO	RECALL	MFGR.	MODEL NO	PAN NO	RECALL
WVTK	50564	667	01/92	FLUKE	8800A	105	8/27/91
TEKTRONIX	TM503	191	8/19/91	TEKTRONIX	DC509	484	9/4/91
TEKTRONIX	PG501	123	9/04/91	TEKTRONIX	7603	318	11/02/91
TEKTRONIX	7B50A	281	12/19/91	TEKTRONIX	7A18	517	9/04/91
HP	432A	660	9/7/91	HP	8478B	431	10/9/91

CALIBRATION TECHNICIAN Luke Hung CALIBRATION DATE 8-8-1991

Wavetek Microwave, Inc. certifies that this instrument meets all of its published specifications and has been calibrated using standards whose accuracies have been compared at planned intervals and are traceable to National Institute of Standards and Technology, have been derived from accepted values of natural physical constants or have been derived by the ratio type of self calibration technique Calibration procedures conform with the requirements of MIL-STD-45662A.

Howard Kehm
Howard Kehm
Metrology Manager


SYM
REVISION
ECO
DATE
LY 13530
ATORS ARE ABBREVIATED
WITH A2
+5V
Q1
2N3644
R17 120
μW
CR1
Q2
2N3644
R18 120
mW
CR2
Q3
2N3644
R19 120
W
CR3
Q4
2N3644
R20 120
KW
CR4
Q5
2N3644
R21 120
dB
CR5
R22 4.7K
POLARITY
ON-OFF
OFFSET
10^-1
10^-2
10^-3
+12.6V
TP21
TP23
J1
J3
U3*
LM302H
FROM
+10dBm
CAL POT
1.75V@1mW
+0.79V @ 1mW
OUTPUT
1ms
PULSE
-12.6V
P.S.
GND
SWITCH POS
MODE
S1-1
60dB COUPLER
S1-2
40dB COUPLER
S1-3
20dB COUPLER
S1-4
DIRECT
DESCRIPTION
NEXT ASSY
DATE
2-9-77
7-7-77
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA
RANGE SWITCH & LAMP DRIVERS
DRAWING NO
13531
REV
C
SHEET 1 OF 1

SYM	REVISION	ECO	DATE

A4
ASSY 13525

ASSEMBLY 13530
REFERENCE DESIGNATORS ARE ABBREVIATED
PREFIX WITH A2

25 27 29 30 26 28 31 32 35
A1 A2 A3 A4 A5 A6 A7 A8 A9
19 12 18 11 14 17 13 15 10

S1-4B1 S1-3B1 S1-2A1 S1-1A1
S1-4A1 S1-3B3 S1-2A3 S1-1B1
S1-4A2 S1-3B2 S1-2A2 S1-1A2
S1-4B2 S1-3A2 S1-2B2
S1-3A1 S1-2B1 S1-1B2
S1-3A3 S1-2B3

R1 63.00K 0.1%

30
OFFSET → 22
$\overline{10^{-1}}$ → 16
$\overline{10^{-2}}$ → 20
$\overline{10^{-3}}$ → 21

μW R2 3.3K R3 10K Q1 2N3644 R17 120 → 8 CR1 μW
mW R5 3.3K R6 10K Q2 2N3644 R18 120 → 7 CR2 mW
W R8 3.3K R9 10K Q3 2N3644 R19 120 → 26 CR3 W
KW R11 3.3K R12 10K Q4 2N3644 R20 120 → 25 CR4 KW
dB R14 3.3K R15 10K Q5 2N3644 R21 120 → 23 CR5 dB
R22 4.7K → 24 POLARITY ON-OFF
6 ← +5V
3

ISOLATION AMPLIFIER | AVERAGE SAMPLER | HOLD AMPLIFIER | AVERAGING AMPLIFIER

+12.6V → 2
-12.6V → 1
P.S. GND → 3
FROM +10dBm CAL POT 1.75V@1mW → 27
28
1ms PULSE → 29

C1 0.1
J1
TP21
C6 .001
R23 48.7K 1%
R24 39.2K 1%
U1* LM302H
Q6 E112
R27 100K
R25 100K
R26 100K
Q7 2N4121
Q8 2N3646
2.3V
R28 22K
Q9 FM3955
C3 .22
R29 61.9K 1%
R30 61.9K 1%
R31 100
BALANCE
R32 10K
U2 741C
R33 100
C5 0.1
R34 100K
R35 22K
U3* LM302H
TP23
J3
5 ← 1
4 ← +0.79V @ 1mW OUTPUT
TP22
J2
C2 0.1
C4 0.1

SWITCH POS	MODE
S1-1	60dB COUPLER
S1-2	40dB COUPLER
S1-3	20dB COUPLER
S1-4	DIRECT

NOTE
UNLESS SPECIFIED OTHERWISE, RESISTOR VALUES ARE IN OHMS AND ARE ±5% 1/4W. CAPACITOR VALUES ARE IN MICROFARADS.

* SELECTED PAIR

ITEM	REQD	PART NO.	DESCRIPTION

LIST OF MATERIAL

NEXT ASSY

FINISH OR TREATMENT

UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE
.XX - .015
.XXX - .005

SCALE

		DATE
DRAWN	YO	2-9-77
ENG	RB	7-7-77
PROD		

PM PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA

RANGE SWITCH & LAMP DRIVERS

DRAWING NO. 13531 REV C

SHEET 1 OF 1

REPLACEABLE PARTS LIST

REF. DESIG.	LOCA-TION	DESCRIPTION	PM PART NO.	TOT. QTY.
		INPUT CIRCUIT PC BOARD ASSEMBLY-13525 (Refer to Fig. 7-5)		
A4C1	F-4	Cap, cer, .01 µF 20% 100 V	10000-11	13
A4C2	F-4	Cap, cer, .01 µF 20% 100 V	10000-11	Ref
A4C3	A-1	Cap, cer, .01 µF 20% 500 V	10000-7	2
A4C4	F-5	Cap, cer, .01 µF 20% 100 V	10000-11	Ref
A4C5	E-3	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	8
A4C6	F-4	Cap, cer, .01 µF 20% 100 V	10000-11	Ref
A4C7	E-3	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A4C8	*	Cap, cer, .01 µF 20% 100 V	10000-11	Ref
A4C9	A-2	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A4C10	B-1	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A4C11	A-2	Cap, Ta, 4.7 µF 20% 15 V	10787-1	1
A4C12	A-2	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A4C13	B-3	Cap, cer, 6.8pF±5% 1000V	10001-9	1
A4C14	B-2	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A4C15	*	Cap, cer, 10 pF ± 5% 1000V	10001-3	2
A4C16	B-4	Cap, cer, 68 pF 5% 1000 V	10001-14	1
A4C17	C-3	Cap, cer, .0022 µF 20% 500 V	10000-5	3
A4C18	-	Cap, cer, 470 pF ±20% 1000V	10000-3	2
A4C19	D-2	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A4C20	D-3	Cap, cer, 150 pF 5% 1000 V	10001-15	1
A4C21	D-2	Cap, cer, .001 µF ±5% 1000 V	10585-5	2
A4C22	D-2	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A4C23	D-3	Cap, cer, .01 µF 20% 100 V	10000-11	Ref
A4C24	C-2	Cap, mica, .0025 µF 5% 500 V	10677-3	1
A4C25	C-1	Cap, cer, .0022 µF 20% 500 V	10000-5	Ref
A4C26	C-1	Cap, cer, .0022 µF 20% 500 V	10000-5	Ref
A4C27	B-1	Cap, cer, .01 µF 20% 500 V	10000-7	Ref
A4C28	D-2	Cap, cer, 10 pF 5% 1000 V	10001-3	Ref
A4C29	-	Not Used		
A4C30	C-5	Cap, mylar, .047 µF 10% 200 V	10007-6	1
A4C31	C-4	Cap, cer, .01 µF 20% 100 V	10000-11	Ref
A4C32	C-4	Cap, cer, .01 µF 20% 100 V	10000-11	Ref
A4C33	A-5	Cap, mylar, 0.1 µF 10% 200 V	10007-7	3
A4C34	B-5	Cap, mylar, 0.1 µF 10% 200 V	10007-7	Ref
A4C35	B-5	Cap, mylar, .001 µF 10% 200 V	10007-1	1
A4C36	B-4	Cap, cer, 100 pF 20% 1000 V	10000-1	3
A4C37	B-4	Cap, cer, .01 µF 20% 100 V	10000-11	Ref
A4C38	B-5	Cap, mylar, 0.1 µF 10% 200 V	10007-7	Ref
A4C39	B-4	Cap, cer, .01 µF 20% 100 V	10000-11	Ref
A4C40	B-5	Cap, Ta, 1.0 µF 20% 35 V	10787-5	1
A4C41	B-5	Cap, cer, 100 pF 20% 1000 V	10000-1	Ref
A4C42	A-4	Cap, cer, .01 µF 20% 100 V	10000-11	Ref
A4C43	B-4	Cap, cer, 100 pF 20% 1000 V	10000-1	Ref
A4C44	B-4	Cap, cer, .01 µF 20% 100 V	10000-11	Ref
A4C45	A-5	Cap, cer, 47 pF 5% 1000 V	10001-6	1
A4C46	A-5	Cap, mylar, .022 µF 10% 200 V	10007-5	1
A4C47	A-3	Cap, Ta, 27 µF 20% 15 V	10787-3	1
A4C48	C-3	Cap, cer, .22pF ±5% 1000V	10001-4	1
A4C49	D-2	Cap, cer, 470 pF ±20% 1000V	10000-3	Ref
A4C50	E-2	Cap, cer, .001 µF ±5% 1000 V	10585-5	Ref
A4C51	E-3	Cap, cer, .01 µF ±20% 100V	10000-11	Ref

* Not Illustrated

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	HP PART NO.	TOT. QTY.
A4CR1	D-4	Diode, 1N4148	10043	17
A4CR2	E-3	Diode, 1N4148	10043	Ref
A4CR3	B-6	Diode, 1N4148	10043	Ref
A4CR4	-	Not Used		
A4CR5	B-3	Diode, 1N4148	10043	Ref
A4CR6	B-3	Diode, 1N4148	10043	Ref
A4CR7	D-3	Diode, 1N4148	10043	Ref
A4CR8	D-3	Diode, 1N4148	10043	Ref
A4CR9	C-1	Diode, 1N4148	10043	Ref
A4CR10	C-1	Diode, 1N4148	10043	Ref
A4CR11	E-1	Diode, 1N4148	10043	Ref
A4CR12	E-2	Diode, 1N4148	10043	Ref
A4CR13	E-2	Diode, 1N4148	10043	Ref
A4CR14	E-2	Diode, 1N4148	10043	Ref
A4CR15	E-3	Diode, 1N4148	10043	Ref
A4CR16	E-3	Diode, 1N4148	10043	Ref
A4CR17	E-3	Diode, 1N4148	10043	Ref
A4CR18	E-3	Diode, 1N4148	10043	Ref
A4J1	D-4	Test Jack, Yellow	10140-2	10
A4J2	E-5	Test Jack, Yellow	10140-2	Ref
A4J3	E-5	Test Jack, Black	10140-3	1
A4J4	D-5	Test Jack, Yellow	10140-2	Ref
A4J5	D-4	Test Jack, Yellow	10140-2	Ref
A4J6	B-4	Test Jack, Yellow	10140-2	Ref
A4J7	D-2	Test Jack, Yellow	10140-2	Ref
A4J8	A-1	Test Jack, Yellow	10140-2	Ref
A4J9	A-4	Test Jack, Yellow	10140-2	Ref
A4J10	D-4	Test Jack, Yellow	10140-2	Ref
A4J11	D-2	Test Jack, Yellow	10140-2	Ref
A4L1	D-3	Coil, RF 18 µH 10%	10631-2	1
A4Q1	E-4	Transistor, FM3955	11432	3
A4Q2	E-5	Transistor, 2N4121	10398	4
A4Q3	D-5	Transistor, 2N2221	13534	1
A4Q4	D-5	Transistor, 2N3053	10206	1
A4Q5	D-4	Transistor, 2N4250	11119	6
A4Q6	A-6	Transistor, 2N3569	10017	2
A4Q7	-	Not Used		
A4Q8	B-3	Transistor, TIS97	11507	1
A4Q9	D-4	Transistor, *MFE 3004 or 3N138	10896	4
A4Q10	C-3	Transistor, FM3955	11432	Ref
A4Q11	C-3	Transistor, 2N3565	10019	4
A4Q12	C-3	Transistor, 2N4250	11119	Ref
A4Q13	C-3	Transistor, 2N4250	11119	Ref
A4Q14	C-3	Transistor, 2N3569	10017	Ref
A4Q15	D-3	Transistor, 2N4121	10398	Ref
A4Q16	-	Not Used		
A4Q17	D-2	Transistor, 2N3646	10018	1
A4Q18	C-2	Transistor, E112	12591	2
A4Q19	C-2	Transistor, FM3955	11432	Ref
A4Q20	C-2	Transistor, 2N3565	10019	Ref
A4Q21	C-2	Transistor, 2N4250	11119	Ref
A4Q22	B-2	Transistor, 2N4250	11119	Ref
A4Q23	B-2	Transistor, 2N3440	11433	2
A4Q24	B-1	Transistor, 2N3440	11433	Ref

*Must come all from same mfr.

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PM PART NO.	TOT. QTY.
A4Q25	-	Not Used		
A4Q26	C-4	Transistor, 2N4250	11119	Ref
A4Q27	C-5	Transistor, 2N3565	10019	Ref
A4Q28	C-5	Transistor, 2N3565	10019	Ref
A4Q29	B-5	Transistor, *MFE 3004 or 3N138	10896	Ref
A4Q30	B-5	Transistor, *MFE 3004 or 3N138	10896	Ref
A4Q31	B-5	Transistor, 2N4360	10339	1
A4Q32	A-4	Transistor, E112	12591	Ref
A4R1	F-4	Res, car flm, 100 Ω 5% 1/4 W	10013-13	10
A4R2	E-4	Res, met flm, 39.2 KΩ 1% 1/8 W	10015-61	3
A4R3	D-4	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	5
A4R4	F-4	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A4R5	E-4	Res, met flm, 61.9 KΩ 1% 1/8 W	10015-25	2
A4R6	E-5	Res, met flm, 61.9 KΩ 1% 1/8 W	10015-25	Ref
A4R7	E-4	Res, var comp, 10 KΩ 20% 1/4 W	10046-8	2
A4R8	F-6	Res, car comp, 1.5 MΩ 5% 1/4 W	10013-63	1
A4R9	F-5	Res, var comp, 1 MΩ 20% 1/4 W	10046-13	2
A4R10	F-5	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A4R11	F-5	Res, car flm, 680 Ω 5% 1/4 W	10013-23	1
A4R12	E-5	Res, var comp, 1 KΩ 20% 1/4 W	10046-7	1
A4R13	E-5	Res, met flm, 5.62 KΩ 1% 1/8 W	10015-104	1
A4R14	F-4	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A4R15	F-5	Res, met flm, 30.1 KΩ 1% 1/8 W	10015-116	1
A4R16	F-5	Res, met flm, 121 KΩ 1% 1/8 W	10015-43	1
A4R17	F-4	Res, var cerm, 100 KΩ 20% 1/4 W	11711-2	1
A4R18	E-5	Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	2
A4R19	F-6	Res, met flm, 63.00 KΩ 0.1% 1/8 W	11485-13	1
A4R20	E-6	Res, WW, 17.555 KΩ .05% 1/8 W	10725-4	2
A4R21	C-6	Res, WW, 17.555 KΩ .05% 1/8 W	10725-4	Ref
A4R22	D-6	Res, WW, 158.00 KΩ .05% 1/8 W	10725-7	2
A4R23	D-6	Res, WW, 142.20 KΩ .05% 1/8 W	10725-5	1
A4R24	D-6	Res, WW, 158.00 KΩ .05% 1/8 W	10725-7	Ref
A4R25	E-6	Res, WW, 15.800 KΩ .05% 1/8 W	10725-8	1
A4R26	E-5	Res, car flm, 6.8 KΩ 5% 1/4 W	10013-35	1
A4R27	E-5	Res, car flm, 10 KΩ 5% 1/4 W	10013-37	3
A4R28	D-5	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	Ref
A4R29	D-4	Res, met flm, 31.6 KΩ 1% 1/8 W	10015-14	1
A4R30	D-4	Res, car flm, 22 Ω 5% 1/4 W	10013-5	2
A4R31	D-4	Res, car flm, 1 KΩ 5% 1/4 W	10013-25	6
A4R32	D-4	Res, car flm, 2.2 KΩ 5% 1/4 W	10013-29	6
A4R33	D-4	Res, car flm, 1KΩ 5% 1/4W	10013-25	Ref
A4R34	D-4	Res, car flm, 470Ω 5% 1/4W	10013-21	8
A4R35	C-6	Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A4R36	C-6	Res, met flm, 21.5 KΩ 1% 1/8 W	10015-15	1
A4R37	C-6	Res, car flm, 150 KΩ 5% 1/4 W	10013-51	2
A4R38	C-5	Res, var comp, 100 KΩ 20% 1/4 W	10046-10	5
A4R39	A-6	Res, car flm, 3.3 KΩ 5% 1/4 W	10013-31	4
A4R40	- -	Not Used		
A4R41	A-6	Res, car flm, 220 Ω 5% 1/4 W	10013-17	2
A4R42	-	Not Used		
A4R43	-	Not Used		
A4R44	B-3	Pot comp, 100Ω ±20% 1/4W	10046-9	1
A4R45	B-3	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A4R46	B-2	Res, car comp 47 Ω±5% 1/4 W	10142-8	3

*Must come all from same mfr.

REPLACEABLE PARTS LIST

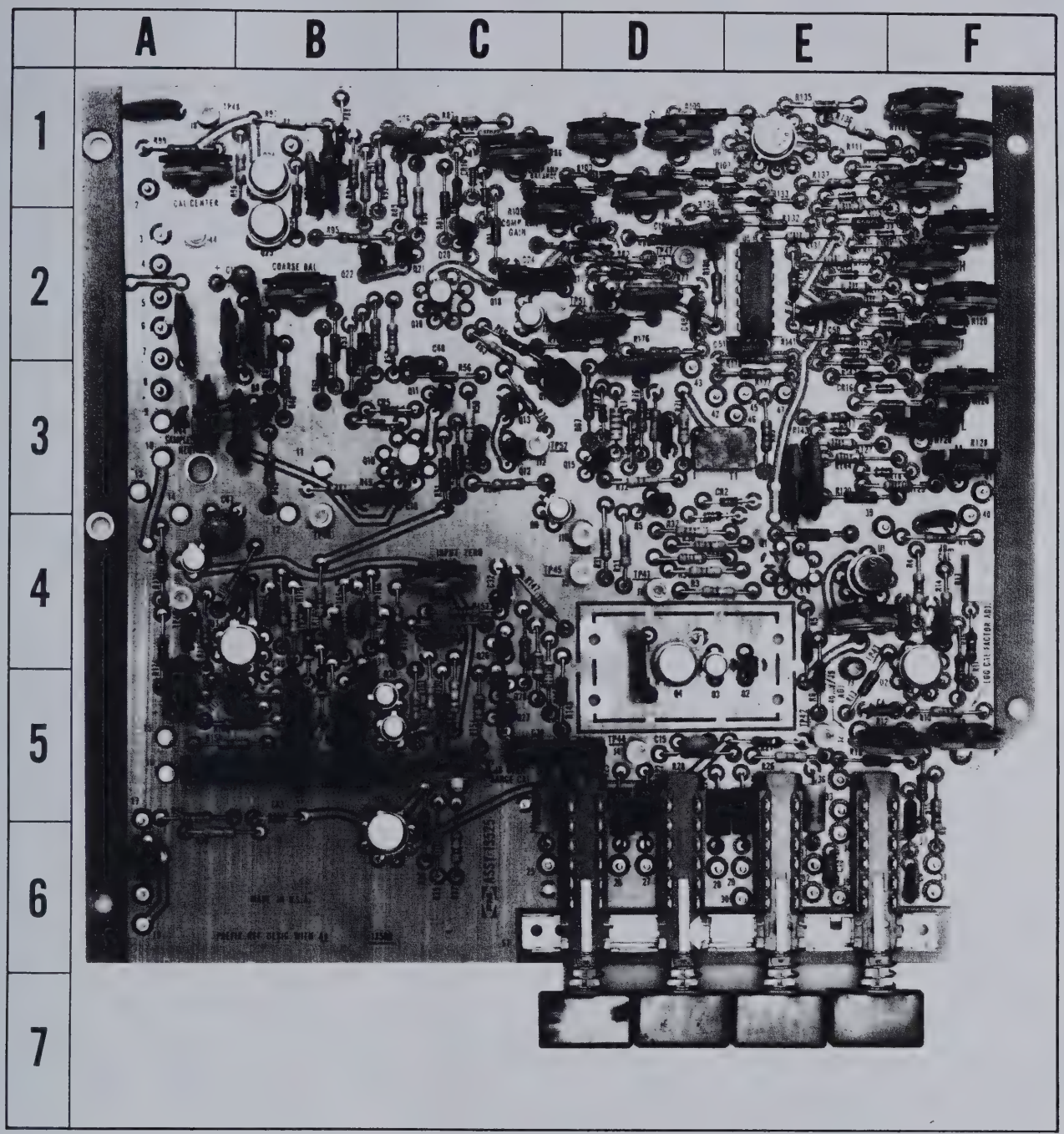
REF. DESIG.	LOCATION	DESCRIPTION	PM PART NO.	TOT. QTY.
A4R47	B-3	Res, car flm, 1.5 K Ω 5% 1/4 W	10013-27	2
A4R48	B-3	Res, car flm, 10 Ω 5% 1/4 W	10013-1	1
A4R49	B-3	Res, car comp, 10 MΩ 5% 1/4 W	10013-73	3
A4R50	C-3	Res, car comp 47 Ω±5% 1/4 W	10142-8	Ref
A4R51	C-3	Res, met flm, 9.53 KΩ 1% 1/8 W	10015-66	2
A4R52	C-3	Res, met flm, 9.53 KΩ 1% 1/8 W	10015-66	Ref
A4R53	B-3	Res, met flm, 4.99 KΩ 1% 1/8 W	10015-65	4
A4R54	B-3	Res, met flm, 6.19 KΩ 1% 1/8 W	10015-105	1
A4R55	B-3	Res, met flm, 4.99 KΩ 1% 1/8 W	10015-65	Ref
A4R56	C-3	Res, met flm, 4.02 KΩ 1% 1/8 W	10015-80	1
A4R57	C-2	Res, car flm, 1 MΩ 5% 1/4 W	10013-61	2
A4R58	C-3	Res, car flm, 470Ω 5% 1/4 W	10013-21	Ref
A4R59	B-2	Res, met flm, 316KΩ 1% 1/8W	10015-141	1
A4R60	B-2	Res, var comp, 100 KΩ 20% 1/4 W	10046-10	Ref
A4R61	B-3	Res, met flm, 1% 1/8 W (Factory Selected Value)		1
A4R62	-	Not Used		
A4R63	C-2	Res, car flm, 4.7 KΩ 5% 1/4 W	10013-33	3
A4R64	-	Not Used		
A4R65	C-2	Res, car flm, 4.7 KΩ 5% 1/4 W	10013-33	Ref
A4R66	D-2	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A4R67	D-3	Res, car flm, 470 Ω 5% 1/4 W	10013-21	Ref
A4R68	D-3	Not Used		
A4R69	E-3	Res, car flm, 22 Ω 5% 1/4 W	10013-5	Ref
A4R70	D-2	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A4R71	D-3	Res, car comp 47 Ω±5% 1/4 W	10142-8	Ref
A4R72	D-3	Res, car flm, 470 Ω 5% 1/4 W	10013-21	Ref
A4R73	D-2	Res, car flm, 47 KΩ 5% 1/4 W	10013-45	4
A4R75	D-3	Res, car flm, 3.3 KΩ 5% 1/4 W	10013-31	Ref
A4R76	D-3	Res, car flm, 1.8 KΩ 5% 1/4 W	10013-28	1
A4R77	D-2	Res, car flm, 22KΩ 5% 1/4W	10013-41	2
A4R78	C-3	Res, car flm, 1KΩ 5% 1/4W	10013-25	Ref
A4R79	D-2	Res, car flm, 22 KΩ 5% 1/4 W	10013-41	Ref
A4R80	C-2	Res, met flm, 49.9 KΩ 1% 1/8 W	10015-133	3
A4R81	C-2	Res, met flm, 4.99 KΩ 1% 1/8 W	10015-65	Ref
A4R82	D-2	Res, car flm, 1 KΩ 5% 1/4 W	10013-25	Ref
A4R83	C-2	Res, met flm, 4.99 KΩ 1% 1/8 W	10015-65	Ref
A4R84	C-1	Res, met flm, 14.7 KΩ 1% 1/8 W	10015-10	1
A4R85		Factory Selected		
A4R86	D-1	Res, var comp, 2 KΩ 20% 1/4 W	10046-5	1
A4R87	C-1	Res, met flm, 19.6 KΩ 1% 1/8 W	10015-60	1
A4R88	B-1	Res, car flm, 680 Ω 5% 1/4 W	10013-23	1
A4R89	B-1	Res, car flm, 470 Ω 5% 1/4 W	10013-21	Ref
A4R90	C-2	Res, car flm, 3.3 KΩ 5% 1/4 W	10013-31	Ref
A4R91	B-1	Res, car flm, 3.3 KΩ 5% 1/4 W	10013-31	Ref
A4R92	B-1	Res, car flm, 470 Ω 5% 1/4 W	10013-21	Ref
A4R93	B-1	Res, car flm, 2.2 KΩ 5% 1/4 W	10013-29	Ref
A4R94	B-2	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	Ref
A4R95	B-2	Res, car flm, 2.2 KΩ 5% 1/4 W	10013-29	Ref
A4R96	B-1	Res, car flm, 47 KΩ 5% 1/4 W	10013-45	Ref
A4R97	B-1	Res, car flm, 150 KΩ 5% 1/4 W	10013-51	Ref
A4R98	A-1	Res, var comp, 100 KΩ 20% 1/4W	10046-10	Ref
A4R99	A-1	Res, car flm, 47 KΩ 5% 1/4 W	10013-45	Ref
A4R100	D-1	Res, met flm, 49.9 KΩ 1% 1/8 W	10015-133	Ref
A4R101	C-2	Res, var comp, 1 MΩ 20% 1/4 W	10046-13	Ref
A4R102	D-2	Res, met flm, 499 KΩ 1% 1/8 W	10015-45	2

REPLACEABLE PARTS LIST

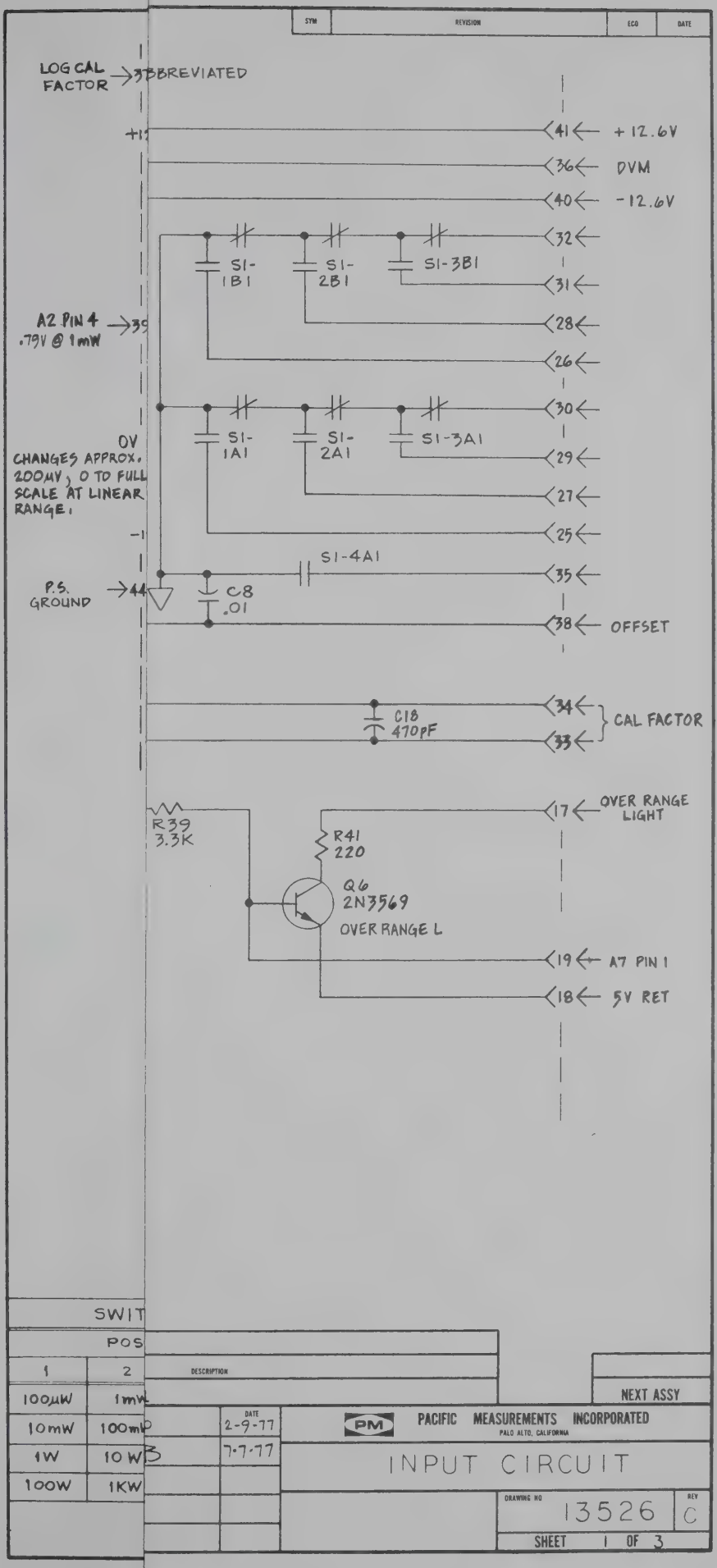
REF. DESIG.	LOCATION	DESCRIPTION	PM PART NO.	TOT. QTY.
A4R103	D-1	Res, met flm, 499 KΩ 1% 1/8 W	10015-45	Ref
A4R104	D-2	Res, var comp, 100 KΩ 20% 1/4 W	10046-10	Ref
A4R105	D-1	Res, met flm, 154 KΩ 1% 1/8 W	10015-26	1
A4R106	D-1	Res, var comp, 50 KΩ 20% 1/4 W	10046-3	4
A4R107	D-1	Res, met flm, 215 KΩ 1% 1/8 W	10015-5	2
A4R108	D-1	Res, var comp, 50 KΩ 20% 1/4 W	10046-3	Ref
A4R109	D-1	Res, met flm, 191 KΩ 1% 1/8 W	10015-108	1
A4R110	F-1	Res, var comp, 50 KΩ 20% 1/4 W	10046-3	7
A4R111	E-1	Res, met flm, 90.9KΩ 1% 1/8 W	10015-91	1
A4R112	F-1	Res, var comp, 50 KΩ 20% 1/4 W	10046-3	Ref
A4R113	E-1	Res, met flm, 90.9 Ω 1% 1/8 W	10015-91	1
A4R114	F-2	Res, var comp, 50KΩ 20% 1/4 W	10046-3	Ref
A4R115	E-2	Res, met flm, 80.6 KΩ 1% 1/8 W	10015-183	1
A4R116	F-2	Res, var comp, 50KΩ 20% 1/4 W	10046-3	Ref
A4R117	E-2	Res, met flm, 57.6 KΩ 1% 1/8 W	10015-115	1
A4R118	F-2	Res, var comp, 50 KΩ 20% 1/4 W	10046-3	Ref
A4R119	E-2	Res, met flm, 40.2 KΩ 1% 1/8 W	10015-218	Ref
A4R120	F-2	Res, var comp, 50 KΩ 20% 1/4 W	10046-3	Ref
A4R121	F-2	Res, met flm, 24.9 KΩ 1% 1/8 W	10015-90	Ref
A4R122	F-2	Res, var comp, 50 KΩ 20% 1/4 W	10046-3	Ref
A4R123	E-3	Res, met flm, 15 KΩ 1% 1/8 W	10015-87	2
A4R124	F-3	Res, var comp, 50 KΩ 20% 1/4 W	10046-3	Ref
A4R125	F-3	Res, met flm, 15 KΩ 1% 1/8 W	10015-87	Ref
A4R126	F-3	Res, var comp, 20 KΩ 20% 1/4 W	10046-2	2
A4R127	E-2	Res, met flm, 10 KΩ 1% 1/8 W	10015-7	Ref
A4R128	F-3	Res, var comp, 20 KΩ 20% 1/4 W	10046-2	Ref
A4R129	F-3	Res, met flm, 10 KΩ 1% 1/8 W	10015-7	Ref
A4R130	E-4	Res, met flm, 169 Ω 1% 1/8 W	10015-155	1
A4R131	E-2	Res, met flm, 806 Ω 1% 1/8 W	10015-154	1
A4R132	E-2	Res, met flm, 39.2 Ω 1% 1/8 W	10015-137	1
A4R133	E-2	Res, met flm, 11.5 Ω 1% 1/8 W	10015-148	1
A4R134	D-2	Res, met flm, 16.9 Ω 1% 1/8 W	10015-149	1
A4R135	E-1	Res, met flm, 27.4 Ω 1% 1/8 W	10015-88	1
A4R136	E-1	Res, met flm, 46.4 Ω 1% 1/8 W	10015-150	1
A4R137	E-1	Res, met flm, 43.2 Ω 1% 1/8 W	10015-128	1
A4R138	E-2	Res, met flm, 59.0 Ω 1% 1/8 W	10015-151	1
A4R139	E-2	Res, met flm, 75.0 Ω 1% 1/8 W	10015-113	1
A4R140	E-2	Res, met flm, 100 Ω 1% 1/8 W	10015-68	1
A4R141	E-2	Res, met flm, 127 Ω 1% 1/8 W	10015-145	1
A4R142	E-3	Res, met flm, 162 Ω 1% 1/8 W	10015-146	1
A4R143	E-3	Res, met flm, 196 Ω 1% 1/8 W	10015-69	1
A4R144	E-3	Res, met flm, 255 Ω 1% 1/8 W	10015-44	1
A4R145	-	Not Used		
A4R146	-	Not Used		
A4R147	C-4	Res, met flm, 287 KΩ 1% 1/8 W	10015-85	1
A4R148	D-5	Res, met flm, 215 KΩ 1% 1/8 W	10015-5	Ref
A4R149	C-5	Res, car flm, 47 KΩ 5% 1/4 W	10013-45	Ref
A4R150	C-5	Res, met flm, 39.2 KΩ 1% 1/8 W	10015-61	Ref
A4R151	C-5	Res, met flm, 143 KΩ 1% 1/8 W	10015-67	1
A4R152	C-5	Res, met flm, 11.3 KΩ 1% 1/8 W	10015-81	1
A4R153	C-5	Res, car flm, 680 KΩ 5% 1/4 W	10013-59	1
A4R154	C-5	Res, met flm, 464 KΩ 1% 1/8 W	10015-6	1
A4R155	C-5	Res, met flm, 38.3 KΩ 1% 1/8 W	10015-8	1
A4R156	C-4	Res, car flm, 1 KΩ 5% 1/4 W	10013-25	Ref
A4R157	C-4	Res, car flm, 1 KΩ 5% 1/4 W	10013-25	Ref
A4R158	B-5	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	Ref

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PM PART NO.	TOT. QTY.
A4R159	C-4	Res, car flm, 220 KΩ 5% 1/4 W	10013-53	1
A4R160	C-4	Res, var comp, 100 KΩ 20% 1/4 W	10046-10	Ref
A4R161	C-5	Res, car flm, 10 Ω 5% 1/4 W	10013-1	Ref
A4R162	B-5	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	Ref
A4R163	B-4	Res, car flm, 2.2 KΩ 5% 1/4 W	10013-29	Ref
A4R164	B-5	Res, car flm, 4.7 KΩ 5% 1/4 W	10013-33	Ref
A4R165	B-4	Res, car comp, 10 MΩ 5% 1/4 W	10013-73	Ref
A4R166	B-4	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A4R167	B-4	Res, car comp, 4.7 MΩ 5% 1/4 W	10013-69	2
A4R168	B-5	Res, car flm, 1.5 KΩ 5% 1/4 W	10013-27	Ref
A4R169	B-4	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A4R170	B-4	Res, car flm, 330 Ω 5% 1/4 W	10013-19	1
A4R171	B-4	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A4R172	A-5	Res, car comp, 4.7 MΩ 5% 1/4 W	10013-69	Ref
A4R173	A-4	Res, car flm, 220 Ω 5% 1/4 W	10013-17	Ref
A4R174	A-4	Res, car flm, 10 KΩ 5% 1/4 W	10013-37	Ref
A4R175	A-4	Res, car flm, 470 KΩ 5% 1/4 W	10013-57	1
A4R176	D-3	Res, car flm, 470 Ω±5% 1/4 W	10013-21	Ref
A4R177	E-3	Res, car flm, 2.2 KΩ±5% 1/4 W	10013-29	Ref
A4R178	E-3	Res, car flm, 2.2 KΩ±5% 1/4 W	10013-29	Ref
A4R179	E-2	Res, car flm, 10 KΩ±5% 1/4 W	10013-37	Ref
A4R180	E-2	Res, car flm, 470 Ω±5% 1/4W	10013-21	Ref
A4RT1	D-5	Thermistor	10209	1
A4S1	E-6	Switch, Pushbutton	12027	1
A4T1	E-3	Transformer, Pulse 4:2:1	11962	1
A4U1	E-4	IC, Op Amp 741C	11539	3
A4U2	F-5	IC, Op Amp 741C	11539	Ref
A4U3	B-6	IC, Op Amp 741C	11539	Ref
A4U4		Not Used		
A4U5	E-2	IC, Monostable Multivibrator SN74121N	11270-24	1
A4U6	E-1	IC, 6 Diode Array CA 3039	11118	1
A4U7	B-4	IC, Op Amp 709C	10769	1
		Socket IC, 14 Pin	10978-1	1



INPUT CIRCUIT BOARD ASSEMBLY
FIGURE 7-5


SYM
REVISION
ECO
DATE
LOG CAL FACTOR → 37 ABBREVIATED
41 ← + 12.6V
36 ← DVM
40 ← - 12.6V
S1-1B1
S1-2B1
S1-3B1
32 ←
31 ←
A2 PIN 4 → 39
.79V @ 1mW
28 ←
26 ←
S1-1A1
S1-2A1
S1-3A1
30 ←
29 ←
0V
CHANGES APPROX. 200MV, 0 TO FULL SCALE AT LINEAR RANGE.
27 ←
25 ←
S1-4A1
35 ←
P.S. GROUND → 44
C8 .01
38 ← OFFSET
C18 470pF
34 ←
33 ←
CAL FACTOR
R39 3.3K
17 ← OVER RANGE LIGHT
R41 220
Q6 2N3569
OVER RANGE L
19 ← A7 PIN 1
18 ← 5V RET
SWIT
POS
1
2
100μW
1mW
10mW
100mW
1W
10W
100W
1KW
DESCRIPTION
DATE
2-9-77
7-7-77
B
NEXT ASSY
PM
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA
INPUT CIRCUIT
DRAWING NO
13526
REV
C
SHEET 1 OF 3

STM	REVISION	ECO	DATE

ASSEMBLY 13525
REFERENCE DESIGNATORS ARE ABBREVIATED
PREFIX WITH A4

LOG/LIN AMPLIFIER

LOG POST AMPLIFIER

LOG CAL FACTOR → 37

+12.6V — R1 100 — C1 .01

A2 PIN 4 .79V @ 1mW → 39 — R2 39.2K 1% — Q1 FM3955 (D1, D2, G1, G2, S1, S2)

J1 — R3 100K

OV CHANGES APPROX. 200μV, 0 TO FULL SCALE AT LINEAR RANGE. — TP41

R4 100 — -12.6V

R5 61.9K 1% — R6 61.9K 1%

LOG/LIN AMP BAL — R7 10K

U1 741C

C2 .01

P.S. GROUND → 44 — C3 .01

TP43 — J3 — C15 10PF — S1-4A2

S1-1A2 — R20 17.555K .05% — R21 17.555K .05% — S1-3A2 — R27 10K — R26 6.8K

R8 1.5M — R9 1M — LOG CAL FACTOR ADJ

U2 741C — C4 .01 — C5 0.1 — R10 100

R11 680 — 40mV/dB ADJ — R12 1K — R13 5.62K 1%

R14 100 — C6 .01 — C7 0.1

R15 30.1K 1% — R16 121K 1% — R17 100K — dBm CAL

R18 1.00K 1% — R19 63.00K 0.1%

TP42 — J2 — S1-4B2

C18 470PF

41 ← +12.6V
36 ← DVM
40 ← -12.6V
32 ← S1-1B1, S1-2B1, S1-3B1
31
28
26
30 ← S1-1A1, S1-2A1, S1-3A1
29
27
25
35 ← S1-4A1 — C8 .01
38 ← OFFSET
34 } CAL FACTOR
33 }

R22 158.00K .05% — R23 142.20K .05% — S1-1B2

R24 158.00K .05% — S1-2B2

R25 15.800K .05% — S1-3A2

J4 — TP44 — -.58V @ +10 — R28 100K

LOGGING TRANSISTOR

OVEN ASSY

Q2 2N4121 — UNDER OVEN COVER

Q3 2N2221

RT1

OVEN TEMP REGULATOR

CR1 IN4148 — R32 2.2K

CR2 IN4148 — R31 1K

Q5 2N4250

Q4 2N3053 — HEATER

TP45 — J5

R29 31.6K 1% — R30 22 — R34 470K — R36 21.5K 1%

-12.6V

LOG OVERRANGE COMPARATOR

U3 741C

+12.6V

CR3 IN4148 — R39 3.3K

R41 220 — Q6 2N3569 — OVER RANGE L

17 ← OVER RANGE LIGHT
19 ← A7 PIN 1
18 ← 5V RET

dB OVER-RANGE ADJ — R37 150K — R38 100K

-.56V

SWITCH S1				
POSITION				COUPLER
1	2	3	4	
100μW	1mW	10mW	+10dBm	DIRECT
10mW	100mW	1W	+30dBm	20dB
1W	10W	100W	+20dBW	40dB
100W	1KW	10KW	+10dBKW	60dB

NOTE
UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS AND ARE ±5% 1/4WATT. CAPACITOR VALUES ARE IN MICROFARADS.

ITEM	REQD	PART NO.	DESCRIPTION
			LIST OF MATERIAL

NEXT ASSY

FINISH OR TREATMENT

UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE .XX ± .010 .XXX ± .005

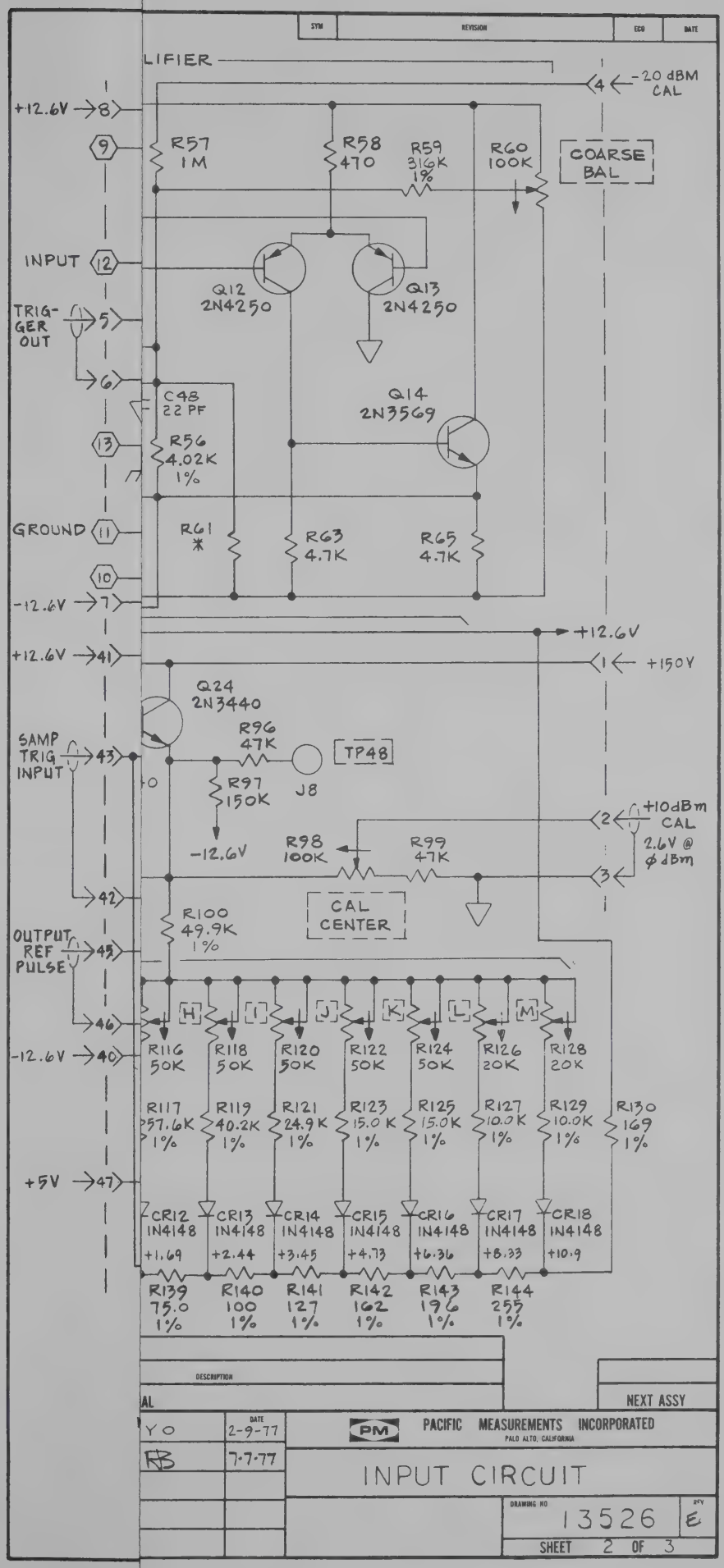
SCALE

DRAWN Yo 2-9-77
ENG RB 7-7-77
PROD

PM PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA

INPUT CIRCUIT

DRAWING NO 13526 REV C
SHEET 1 OF 3


SYM
REVISION
ECO
DATE
LIFIER
-20 dBM CAL
+12.6V
8
9
R57 1M
R58 470
R59 316K 1%
R60 100K
COARSE BAL
INPUT
12
Q12 2N4250
Q13 2N4250
TRIG-GER OUT
5
6
C48 22 PF
Q14 2N3569
13
R56 4.02K 1%
GROUND
11
R61 *
R63 4.7K
R65 4.7K
10
-12.6V
7
+12.6V
+12.6V
41
+150V
1
Q24 2N3440
SAMP TRIG INPUT
43
R96 47K
TP48
J8
R97 150K
-12.6V
+10dBm CAL
2.6V @ ϕ dBm
2
R98 100K
R99 47K
3
42
CAL CENTER
R100 49.9K 1%
OUTPUT REF PULSE
45
H
I
J
K
L
M
46
-12.6V
40
R116 50K
R118 50K
R120 50K
R122 50K
R124 50K
R126 20K
R128 20K
R117 57.6K 1%
R119 40.2K 1%
R121 24.9K 1%
R123 15.0K 1%
R125 15.0K 1%
R127 10.0K 1%
R129 10.0K 1%
R130 169 1%
+5V
47
CR12 IN4148
CR13 IN4148
CR14 IN4148
CR15 IN4148
CR16 IN4148
CR17 IN4148
CR18 IN4148
+1.69
+2.44
+3.45
+4.73
+6.36
+8.33
+10.9
R139 75.0 1%
R140 100 1%
R141 127 1%
R142 162 1%
R143 196 1%
R144 255 1%
DESCRIPTION
AL
NEXT ASSY
Y O
DATE 2-9-77
RB
7-7-77
PM
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA
INPUT CIRCUIT
DRAWING NO 13526
REV E
SHEET 2 OF 3

TRIGGER/MONITOR PICK-OFF AMPLIFIER | FIRST SAMPLER | SAMPLER ISOLATION AMPLIFIER | COMPENSATION AMPLIFIER | 1ST SAMPLER DRIVE | 2ND SAMPLER DRIVE | FEEDBACK SHAPING CIRCUIT

+12.6V, -12.6V, +5V, GROUND, INPUT, TRIGGER OUT, SAMP TRIG INPUT, OUTPUT REF PULSE, -20 dBM CAL, +150V, +10dBm CAL 2.6V @ 0 dBm

C12 0.1, C13 6.8PF, C9 0.1, C10 0.1, C19 0.1, C20 150pF, C21 .001, C22 0.1, C23 .01, C24 .0025, C25 .0022, C26 .0022, C27 .01, C28 10PF, C48 22 PF, C49 470pF, C50 .001, C51 .01

SAMPLER NEUT. R44 100

R45 100, R46 47, R47 1.5K, R48 10, R49 10M, R50 47, R51 9.53K 1%, R52 9.53K 1%, R53 4.99K 1%, R54 6.19K 1%, R55 4.99K 1%, R56 4.02K 1%, R57 1M, R58 470, R59 31.6K 1%, R60 100K COARSE BAL, R61 *, R63 4.7K, R65 4.7K, R66 100, R67 470, R69 22, R70 100, R71 47, R72 470, R73 47K, R75 3.3K, R76 1.8K, R77 22K, R78 1K, R79 22K, R80 49.9K 1%, R81 4.99K 1%, R82 1K, R83 4.99K 1%, R84 14.7K 1%, R85 * 1%, R86 2K, R87 19.6K 1%, R88 680, R89 470, R90 3.3K, R91 3.3K, R92 470, R93 2.2K, R94 100K, R95 2.2K, R96 47K, R97 150K, R98 100K, R99 47K, R100 49.9K 1%, R101 1M, R102 499K 1%, R103 499K 1%, R104 100K, R105 154K 1%, R106 50K, R107 215K 1%, R108 50K, R109 191K 1%, R110 50K, R111 90.9K 1%, R112 50K, R113 90.9K 1%, R114 50K, R115 80.6K 1%, R116 50K, R117 57.6K 1%, R118 50K, R119 40.2K 1%, R120 50K, R121 24.9K 1%, R122 50K, R123 15.0K 1%, R124 50K, R125 15.0K 1%, R126 20K, R127 10.0K 1%, R128 20K, R129 10.0K 1%, R130 169 1%, R131 806 1%, R132 39.2 1%, R133 11.5 1%, R134 16.9 1%, R135 27.4 1%, R136 46.4 1%, R137 43.2 1%, R138 59.0 1%, R139 75.0 1%, R140 100 1%, R141 127 1%, R142 162 1%, R143 196 1%, R144 255 1%, R176 470, R177 2.2K, R178 2.2K, R179 10K, R180 470

Q8 TIS97, Q9 **MFE3004 OR 3N138, Q10 FM3955, Q11 2N3565, Q12 2N4250, Q13 2N4250, Q14 2N3569, Q15 2N4121, Q17 2N3646, Q18 E112, Q19 FM3955, Q20 2N3565, Q21 2N4250, Q22 2N4250, Q23 2N3440, Q24 2N3440

CR5 IN4148, CR6 IN4148, CR7 IN4148, CR8 IN4148, CR9 IN4148, CR10 IN4148, CR11 IN4148 +1.09, CR12 IN4148 +1.69, CR13 IN4148 +2.44, CR14 IN4148 +3.45, CR15 IN4148 +4.73, CR16 IN4148 +6.36, CR17 IN4148 +8.33, CR18 IN4148 +10.9

L1 18μH, T1, U5 3N74 12 IN, U6 CA3039

TP46, TP47, TP48, TP50, TP51, TP52, J6, J7, J8, J10, J11, J12

+4V 90ns -12.6, ON 7ms +12, 7μs

NOTE
UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS AND ARE ±5% ¼ WATT. CAPACITOR VALUES ARE IN MICROFARADS.

* FACTORY SELECTED VALUE
** MUST COME FROM SAME MFR.

LIST OF MATERIAL

ITEM	REQD	PART NO	DESCRIPTION

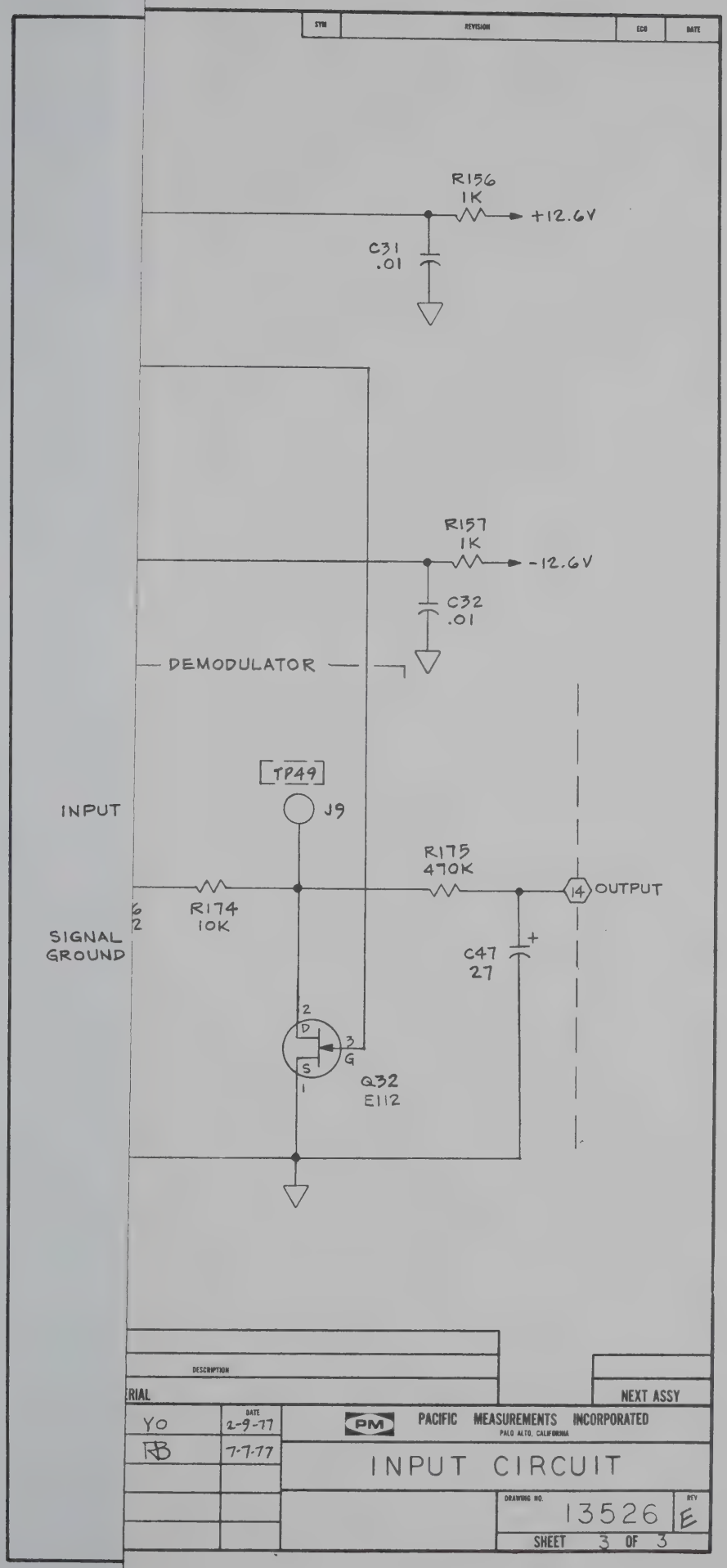
FINISH OR TREATMENT	UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES TOLERANCE XX ± .015 XXX ± .005 SCALE	DRAWN YO 2-9-77	ENG RB 7-7-77

NEXT ASSY

PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO CALIFORNIA

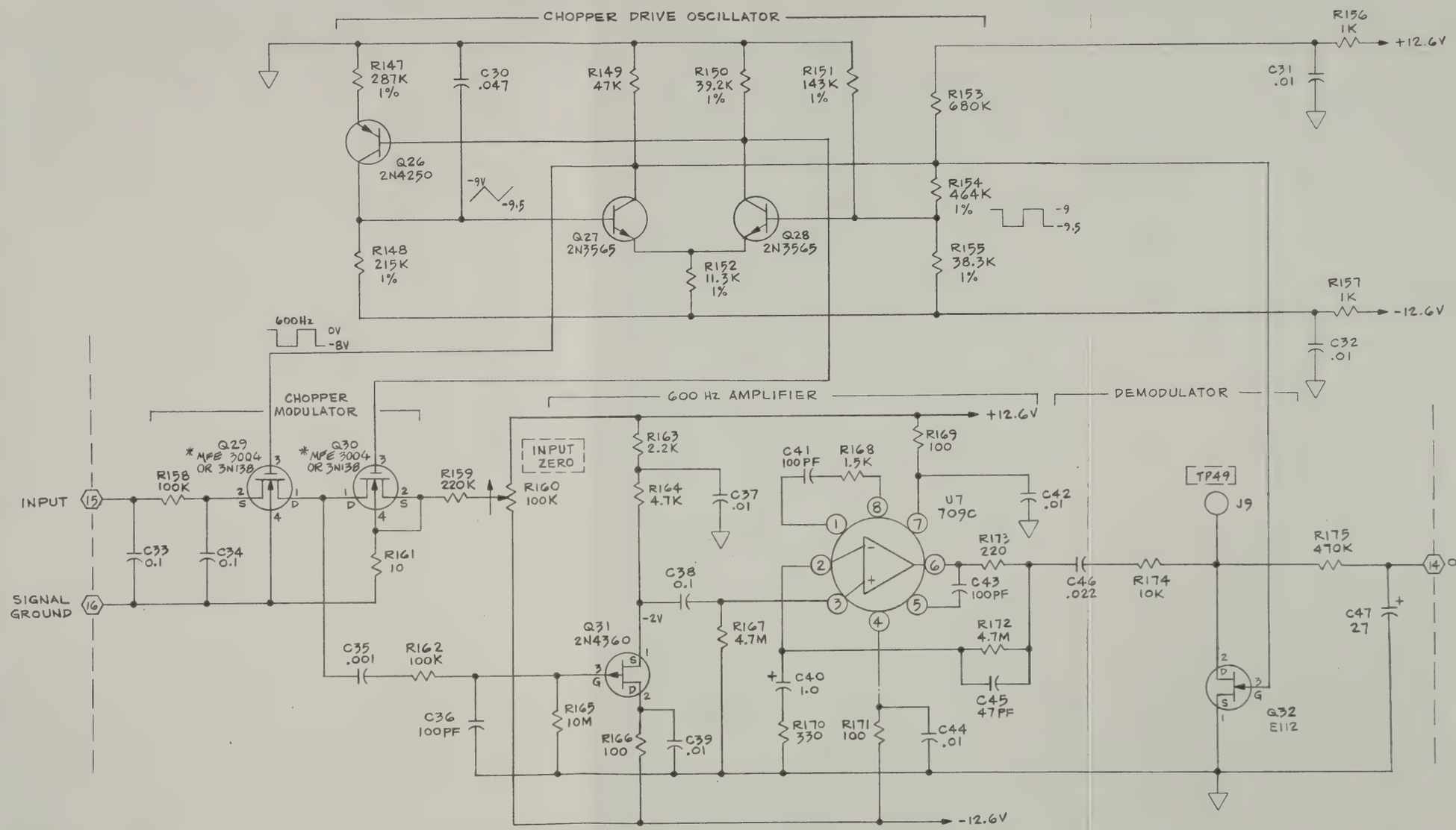
INPUT CIRCUIT

DRAWING NO. 13526 REV E
SHEET 2 OF 3


SYM
REVISION
ECO
DATE
R156
1K
+12.6V
C31
.01
R157
1K
-12.6V
C32
.01
DEMODULATOR
TP49
INPUT
J9
R175
470K
14
OUTPUT
R174
10K
SIGNAL
GROUND
C47
27
2
D
3
G
S
1
Q32
E112
DESCRIPTION
NEXT ASSY
YO
2-9-77
RB
7-7-77
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA
INPUT CIRCUIT
DRAWING NO.
13526
REV
E
SHEET 3 OF 3

SYM	REVISION	ECO	DATE

ASSEMBLY 13525
REFERENCE DESIGNATOR ARE ABBREVIATED
PREFIX WITH A4



NOTE
UNLESS SPECIFIED OTHERWISE, RESISTOR VALUES ARE IN OHMS AND ARE ±5% ¼ WATT. CAPACITOR VALUES ARE IN MICROFARADS.

* MUST COME FROM SAME MFR.

ITEM	REQD	PART NO.	DESCRIPTION
			LIST OF MATERIAL

NEXT ASSY

FINISH OR TREATMENT

UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE
.XX = ±10
.XXX = ±05

SCALE

		DATE
DRAWN	YO	2-9-77
ENG	RB	7-7-77
PROD		

PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA

INPUT CIRCUIT

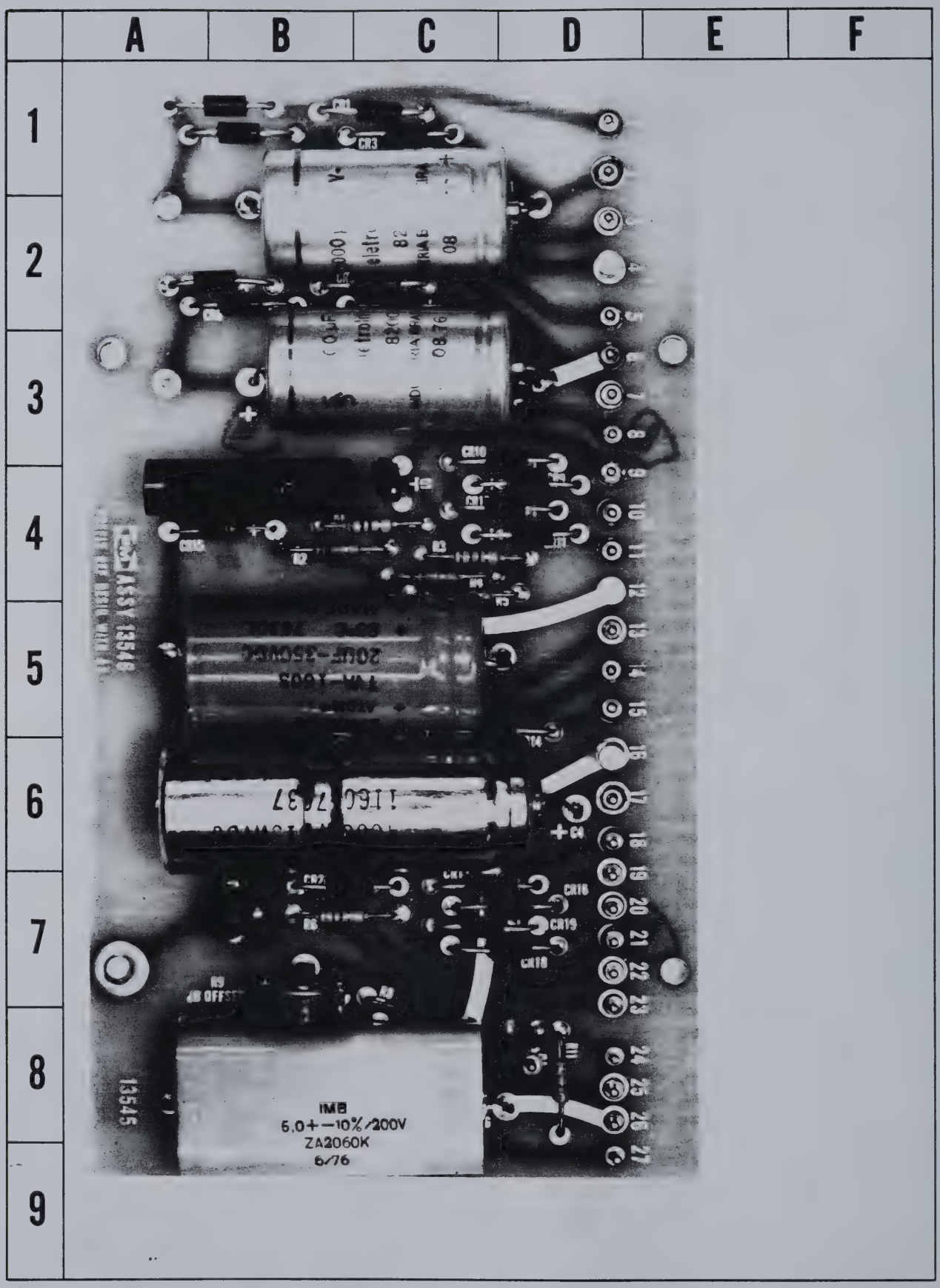
DRAWING NO 13526 REV E

SHEET 3 OF 3

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PART NO.	TOT. QTY.
		RECTIFIER & dB OFFSET PC BOARD ASSEMBLY - 13546 (Refer to Fig. 7-6)		
A5C1	C-2	Cap, elect, 1000 µF 35 V	10003-7	2
A5C2	C-3	Cap, elect, 1000 µF 35 V	10003-7	Ref
A5C3	C-5	Cap, elect, 20 µF 300 V	10003-4	1
A5C4	C-7	Cap, elect, 4000 µF 15 V	10003-3	1
A5C5	B-4	Cap, mylar, 0.22 µF 10% 200 V	10007-8	1
A5C6	B-8	Cap, mylar 5.0µF 10% 200V	10011-1	1
A5CR1	C-1	Diode, 1N4383	10044-1	
A5CR2	B-1	Diode, 1N4383	10044-1	Ref
A5CR3	C-1	Diode, 1N4383	10044-1	Ref
A5CR4	B-1	Diode, 1N4383	10044-1	Ref
A5CR5	C-2	Diode, 1N4383	10044-1	Ref
A5CR6	B-2	Diode, 1N4383	10044-1	Ref
A5CR7	C-3	Diode, 1N4383	10044-1	Ref
A5CR8	B-3	Diode, 1N4383	10044-1	Ref
A5CR9	D-4	Diode, 1N4385	10044-2	4
A5CR10	D-4	Diode, 1N4385	10044-2	Ref
A5CR11	D-4	Diode, 1N4385	10044-2	Ref
A5CR12	D-4	Diode, 1N4385	10044-2	Ref
A5CR13	C-6	Diode, 1N4383	10044-1	Ref
A5CR14	D-6	Diode, 1N4383	10044-1	Ref
A5CR15	B-4	Diode, 1N5276B	11434	1
A5CR16	D-7	Not Used		
A5CR17	D-7	Not Used		
A5CR18	D-7	Not Used		
A5CR19	D-7	Not Used		
A5CR20	D-7	Not Used		
A5CR21	B-8	Diode, IN4148	10043-2	1
A5Q1	C-4	Transistor, 2N5833	11692	1
A5Q2	B-8	Not Used		
A5Q3	-	Not Used		
A5Q4	D-8	Transistor, 2N3565	10019	1
A5R1	C-4	Res, car flm, 100 Ω 5% 1/4 W	10013-13	1
A5R2	C-4	Res, car flm, 10 KΩ 5% 1/4 W	10013-37	1
A5R3	C-5	Res, car flm, 1 KΩ 5% 1/4 W	10013-25	1
A5R4	C-5	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	1
A5R5	C-5	Res, car flm, 470 KΩ 5% 1/4 W	10013-57	1
A5R6	C-8	Not Used		
A5R7	-	Not Used		
A5R8	C-8	Res, met flm 3.48KΩ 1% 1/4W	10015-176	1
A5R9	B-8	Res, var comp 500Ω 20% 1/4W	10046-1	1
A5R10	B-8	Res, met flm 2.00KΩ 1% 1/4W	10015-74	1
A5R11	D-8	Res, car flm 3.3KΩ ±5% 1/4W	10013-31	1

NOTE: See Schematic Diagram 13591 following page 7-5.



RECTIFIER CIRCUIT BOARD ASSEMBLY
FIGURE 7-6

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PART NO.	TOT. QTY.
		TRIGGER CIRCUIT PC BOARD ASSEMBLY - 13522 (Refer to Fig. 7-7)		
A6C1	A-2	Cap, Ta, 68 µF 20% 15 V	10787-4	1
A6C2	B-2	Cap, cer, 6.8 pF 5% 1000 V	10001-9	1
A6C3	B-2	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	9
A6C4	B-3	Cap, cer, 470 pF 20% 1000 V	10000-3	1
A6C5	B-3	Cap, Ta, 12 µF 20% 20 V	10787-2	1
A6C6	C-3	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A6C7	C-2	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A6C8	-	Not Used		
A6C9	B-7	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A6C10	C-8	Cap, cer, .001 µF 20% 1000 V	10000-4	3
A6C11	B-8	Cap, cer, 4.7 pF 5% 1000 V	10001-2	1
A6C12	B-8	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A6C13	B07	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A6C14	E-8	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A6C15	D-6	Cap, mylar, .022 µF 10% 200 V	10007-5	3
A6C16	D-5	Cap, mylar, .022 µF 10% 200 V	10007-5	Ref
A6C17	D-2	Cap, Ta, 2.7 µF 20% 15 V	10787-6	1
A6C18	D-2	Cap, cer, .01 µF 20% 100 V	10000-11	4
A6C19	D-7	Cap, cer, .01 µF 20% 1000 V	10000-11	Ref
A6C20	B-7	Cap, cer, .01 µF 20% 100 V	10000-11	Ref
A6C21	E-3	Cap, Ta, 100 µF 20% 15 V	10787-10	2
A6C22	C-2	Cap, cer, 0.1 µF 20% 15 V	10000-10	Ref
A6C23	C-7	Cap, cer, 220 pF 20% 10000 V	10000-2	1
A6C24	E-7	Cap, Ta, 4.7 µF 20% 35 V	10787-1	3
A6C25	E-4	Cap, Ta, 100 µF 20% 20 V	10787-10	Ref
A6C26	D-4	Cap, cer, .001 µF 20% 1000 V	10000-4	Ref
A6C27	D-3	Cap, Ta, 4.7 µF 20% 35 V	10787-1	Ref
A6C28	C-4	Cap, Ta, 4.7 µF 20% 35 V	10787-1	Ref
A6C29	D-4	Cap, cer, 10 pF 5% 1000V	10001-3	1
A6C30	E-7	Cap, mylar, 0.1 µF 10% 200 V	10007-7	1
A6C31	C-6	Cap, mylar, .022µF 10% 200 V	10007-5	Ref
A6C32	C-5	Cap, cer, 150 pF 20% 1000 V	10000-12	1
A6C33	B-4	Cap, cer, .01 µF 20% 100 V	10000-11	Ref
A6C34	C-4	Cap, mylar, .001 µF 20% 1000 V	10000-4	Ref
A6C35	B-5	Cap, cer, 0.1 µF +80%-20% 100 V	10000-10	Ref
A6C36	D-8	Cap, cer, .0047 µF 20% 500 V	10000-6	1
A6C37	B2	Cap, mylar, .001µ F20% 1000V	10000-4	Ref
A6CR1	B-8	Diode, 1N4148	10043	15
A6CR2	A-7	Diode, 1N4148	10043	Ref
A6CR3	F-7	Diode, 1N4148	10043	Ref
A6CR4	D-2	Diode, 1N4148	10043	Ref
A6CR5	D-8	Diode, 1N4148	10043	Ref
A6CR6	E-8	Diode, 1N4148	10043	Ref
A6CR7	B-7	Diode, 1N4148	10043	Ref
A6CR8	C-8	Diode, 1N4148	10043	Ref
A6CR9	C-8	Diode, 1N4148	10043	Ref
A6CR10	-	Not Used		
A6CR11	C-8	Diode, 1N4148	10043	Ref
A6CR12	D-6	Diode, 1N4148	10043	Ref
A6CR13	E-4	Diode, 1N4148	10043	Ref
A6CR14	D-4	Diode, 1N4148	10043	Ref
A6CR15	B-6	Diode, 1N4148	10043	Ref

REPLACEABLE PARTS LIST

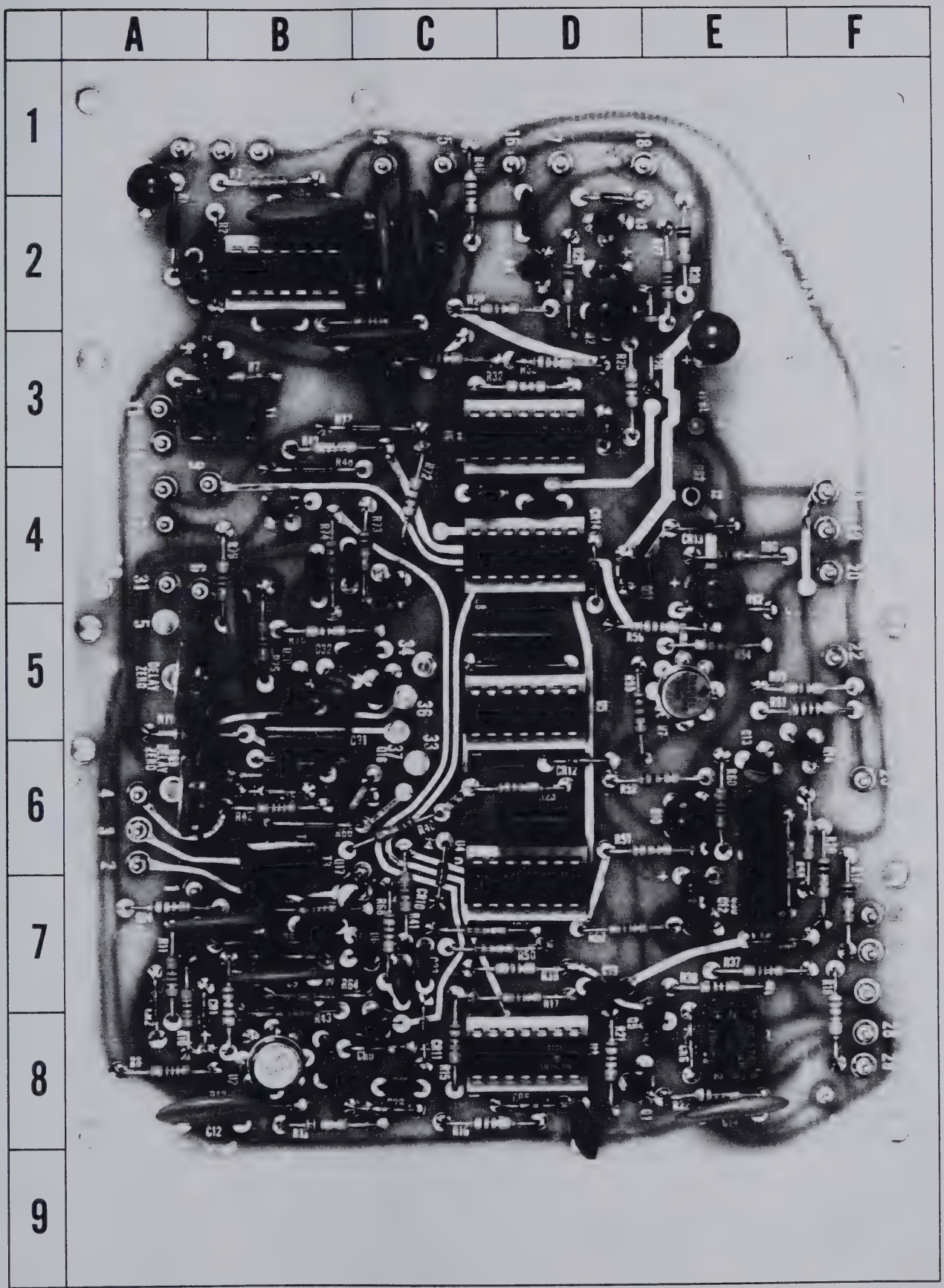
REF. DESIG.	LOCATION	DESCRIPTION	HP PART NO.	TOT. QTY.
A6J1	E-3	Test Jack, Red	10140-1	1
A6J2	E-4	Test Jack, Black	10140-3	1
A6Q1	D-8	Transistor, 2N3646	10018	5
A6Q2	D-3	Transistor, 2N3569	10017	2
A6Q3	D-2	Transistor, 2N3565	10019	3
A6Q4	D-2	Transistor, 2N3565	10019	Ref
A6Q5	E-8	Transistor, 2N3646	10018	Ref
A6Q6	C-7	Transistor, 2N3646	10018	Ref
A6Q7	-	Not Used		
A6Q8	-	Not Used		
A6Q9	B-4	Transistor, 2N3644	10023	2
A6Q10	E-6	Transistor, 2N3569	10017	Ref
A6Q11	D-4	Transistor, 2N4250	11119	3
A6Q12	E-7	Transistor, 2N3565	10019	Ref
A6Q13	E-6	Transistor, 2N4250	11119	Ref
A6Q14	F-6	Transistor, 2N3644	10023	Ref
A6Q15	C-8	Transistor, 2N4121	10398	2
A6Q16	C-6	Transistor, 2N4250	11119	Ref
A6Q17	C-7	Transistor, 2N3646	10018	Ref
A6Q18	C-5	Transistor, 2N4121	10398	Ref
A6Q19	B-5	Transistor, TIS97	11507	2
A6Q20	B-5	Transistor, TIS97	11507	Ref
A6Q21	C-5	Transistor, 2N3646	10018	Ref
A6R1	A-2	Res, met flm, 49.9 Ω 1% 1/8 W	10015-3	1
A6R2	B-2	Res, met flm, 1.54 KΩ 1% 1/8 W	10015-1	1
A6R3	B-1	Res, car flm, 680 Ω 5% 1/4 W	10013-23	1
A6R4	B-2	Res, car flm, 100 Ω 5% 1/4 W	10013-13	8
A6R5	C-3	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A6R6	A-8	Res, car flm, 1 KΩ 5% 1/4 W	10013-25	8
A6R7	B-3	Res, car comp 47 Ω±5% 1/4 W	10142-8	2
A6R8	B-7	Res, car flm, 68 KΩ 5% 1/4 W	10013-47	2
A6R9	B-7	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A6R10	B-7	Res, car flm, 10 KΩ 5% 1/4 W	10013-37	3
A6R11	A-7	Res, car flm, 1 KΩ 5% 1/4 W	10013-25	Ref
A6R12	B-8	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	7
A6R13	B-8	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A6R14	A-7	Res, car flm, 2.2 KΩ 5% 1/4 W	10013-29	9
A6R15	C-8	Res, car flm, 2.2 KΩ 5% 1/4 W	10013-29	Ref
A6R16	C-8	Res, car flm, 2.2KΩ 5% 1/4 W	10013-29	Ref
A6R17	D-7	Res, car flm, 10 KΩ 5% 1/4 W	10013-37	Ref
A6R18	F-7	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	Ref
A6R19	F-8	Res, car flm, 33 KΩ 5% 1/4 W	10013-43	3
A6R20	F-6	Res, car flm, 150 KΩ 5% 1/4 W	10013-51	1
A6R21	D-8	Res, car flm, 2.2 KΩ 5% 1/4 W	10013-29	Ref
A6R22	E-8	Res, car flm, 120 Ω 5% 1/4 W	10013-14	3
A6R23	D-6	Res, car flm, 33 KΩ 5% 1/4 W	10013-43	Ref
A6R24	D-5	Res, car flm, 68 KΩ 5% 1/4 W	10013-47	Ref
A6R25	D-3	Res, car flm, 4.7 KΩ 5% 1/4 W	10013-33	6
A6R26	D-3	Res, car comp, 4.7 MΩ 5% 1/4 W	10013-69	1
A6R27	E-2	Res, car flm, 1 KΩ 5% 1/4 W	10013-25	Ref
A6R28	C-2	Res, car flm, 4.7 KΩ 5% 1/4 W	10013-33	Ref
A6R29	D-2	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	Ref

REPLACEABLE PARTS LIST

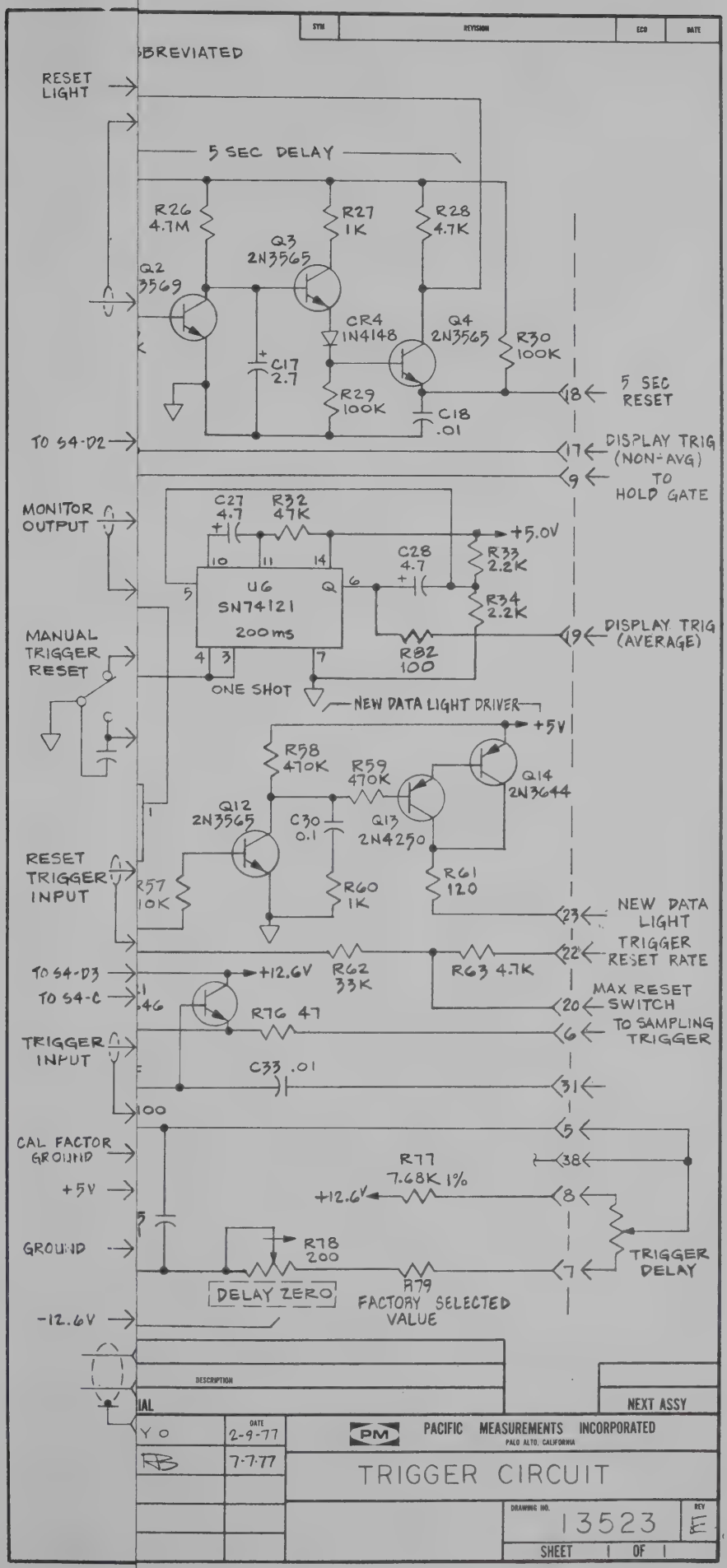
REF. DESIG.	LOCATION	DESCRIPTION	PM PART NO.	TOT. QTY.
A6R30	E-2	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	Ref
A6R31	E-2	Res, car flm, 1 KΩ 5% 1/4 W	10013-25	Ref
A6R32	D-3	Res, car flm, 47 KΩ 5% 1/4 W	10013-45	3
A6R33	D-3	Res, car flm, 2.2 KΩ 5% 1/4 W	10013-29	Ref
A6R34	C-3	Res, car flm, 2.2 KΩ 5% 1/4 W	10013-29	Ref
A6R35	E-8	Res, car flm, 4.7 KΩ 5% 1/4 W	10013-33	Ref
A6R36	C-7	Res, car flm, 22 KΩ 5% 1/4 W	10013-41	2
A6R37	E-7	Res, car flm, 1 KΩ 5% 1/4 W	10013-25	Ref
A6R38	E-7	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A6R39	D-7	Res, car flm, 4.7 KΩ 5% 1/4 W	10013-33	Ref
A6R40	C-6	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	Ref
A6R41	C-7	Res, car flm, 4.7 KΩ 5% 1/4 W	10013-33	Ref
A6R42	B-6	Res, car flm, 1 KΩ 5% 1/4 W	10013-25	Ref
A6R43	B-8	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A6R44	F-2	Res, car flm, 2.2KΩ 5% 1/4W	10013-29	Ref
A6R45	-	Not Used		
A6R46	E-2	Res, car flm, 120 Ω 5% 1/4 W	10013-14	Ref
A6R47	-	Not Used		
A6R48	B-4	Res, met flm, 6.81 KΩ 1% 1/8 W	10015-106	1
A6R49	B-3	Res, met flm, 5.62 KΩ 1% 1/8 W	10015-104	1
A6R50	D-7	Res, car flm, 22 KΩ 5% 1/4 W	10013-41	Ref
A6R51	E-6	Res, car flm, 3.3 KΩ 5% 1/4 W	10013-31	1
A6R52	E-6	Res, car flm, 1 MΩ 5% 1/4 W	10013-61	2
A6R53	-	Not Used		
A6R54	E-5	Res, car flm, 47 KΩ 5% 1/4 W	10013-45	Ref
A6R55	D-5	Res, car flm, 1 MΩ 5% 1/4 W	10013-61	Ref
A6R56	E-5	Res, car flm, 2.2 KΩ 5% 1/4 W	10013-29	Ref
A6R57	D-7	Res, car flm, 10 KΩ 5% 1/4 W	10013-37	Ref
A6R58	F-6	Res, car flm, 470 KΩ 5% 1/4 W	10013-57	2
A6R59	E-6	Res, car flm, 470 KΩ 5% 1/4 W	10013-57	Ref
A6R60	E-6	Res, car flm, 1 KΩ 5% 1/4 W	10013-25	Ref
A6R61	E-5	Res, car flm, 120 Ω 5% 1/4 W	10013-14	Ref
A6R62	E-5	Res, car flm, 33 KΩ 5% 1/4 W	10013-43	Ref
A6R63	E-5	Res, car flm, 4.7 KΩ 5% 1/4 W	10013-33	Ref
A6R64	B-7	Res, car flm, 4.7 KΩ 5% 1/4 W	10013-33	Ref
A6R65	C-6	Res, met flm, 2.00 KΩ 1% 1/8 W	10015-74	1
A6R66	C-6	Res, met flm, 4.02 KΩ 1% 1/8 W	10015-80	1
A6R67	B-6	Res, met flm, 8.25 KΩ 1% 1/8 W	10015-222	1
A6R68	C-7	Res, car flm, 2.2 KΩ 5% 1/4 W	10013-29	Ref
A6R69	B-6	Res, var comp, 5 KΩ 20% 1/4 W	10046-4	1
A6R70	B-7	Res, car flm, 1 KΩ 5% 1/4 W	10013-25	Ref
A6R71	B-5	Res, car flm, 22 Ω 5% 1/4 W	10013-5	1
A6R72	C-4	Res, car flm, 47 KΩ 5% 1/4 W	10013-45	Ref
A6R73	C-4	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	Ref
A6R74	B-4	Res, car flm, 15 KΩ 5% 1/4 W	10013-39	1
A6R75	B-5	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A6R76	B-5	Res, car comp 47 Ω ±5% 1/4 W	10142-8	Ref
A6R77	C-3	Res, met flm, 7.68 KΩ 1% 1/8 W	10015-30	Ref
A6R78	B-5	Res, var comp, 200 Ω 20% 1/4 W	10046-6	1
A6R79	B-4	Res, car flm, 100 Ω 5% 1/4 W	10013-13	Ref
A6R80	E-4	Res, car flm, 100 KΩ 5% 1/4 W	10013-49	Ref
A6R81	-	Not Used		
A6R82	D-4	Res, car flm, 100Ω 5% 1/4W	10013-13	Ref
A6T1	B-3	Transformer, Pulse PE 5761	12134	3
A6T2	E-8	Transformer, Pulse PE 5761	12134	Ref
A6T3	B-7	Transformer, Pulse PE 5761	12134	Ref

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PART NO.	TOT. QTY.
A6U1	B-2	IC, Op Amp, CA3030	11116	1
A6U2	B-8	IC, Diff Comparator, 710C	11230	1
A6U3	D-8	IC, SN74LS10N	13470-6	1
A6U4	D-7	IC, Monostable MV, SN74121N	11270-24	4
A6U5	D-5	IC, Monostable MV, SN74121N	11270-24	Ref
A6U6	D-3	IC, Monostable MV, SN74121N	11270-24	Ref
A6U7	E-5	IC, Op Amp, 741C	11539	1
A6U8	D-4	IC, Monostable MV, SN74121N	11270-24	Ref
A6U9	F-3	IC, SN74LS74N	13470-13	1
		Socket, IC, 14 Pin	10978-1	6



TRIGGER CIRCUIT BOARD ASSEMBLY
FIGURE 7-7


SYM
REVISION
ECO
DATE
BREVIATED
RESET LIGHT
5 SEC DELAY
R26 4.7M
R27 1K
R28 4.7K
Q3 2N3565
Q2 3569
CR4 1N4148
Q4 2N3565
R30 100K
C17 2.7
R29 100K
C18 .01
18 5 SEC RESET
TO S4-D2
17 DISPLAY TRIG (NON-AVG)
9 TO HOLD GATE
MONITOR OUTPUT
C27 4.7
R32 47K
+5.0V
C28 4.7
R33 2.2K
R34 2.2K
U6 SN74121 200ms
R82 100
19 DISPLAY TRIG (AVERAGE)
MANUAL TRIGGER RESET
ONE SHOT
NEW DATA LIGHT DRIVER
+5V
R58 470K
R59 470K
Q14 2N3644
Q12 2N3565
C30 0.1
Q13 2N4250
RESET TRIGGER INPUT
R57 10K
R60 1K
R61 120
23 NEW DATA LIGHT
22 TRIGGER RESET RATE
TO S4-D3
+12.6V
R62 33K
R63 4.7K
TO S4-C
20 MAX RESET SWITCH
R76 47
6 TO SAMPLING TRIGGER
TRIGGER INPUT
C33 .01
31
5
CAL FACTOR GROUND
38
R77 7.68K 1%
+5V
+12.6V
8
GROUND
R78 200
TRIGGER DELAY
DELAY ZERO
R79 FACTORY SELECTED VALUE
7
-12.6V
DESCRIPTION
NEXT ASSY
Y O
2-9-77
RB
7-7-77
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA
TRIGGER CIRCUIT
DRAWING NO.
13523
REV
E
SHEET 1 OF 1

TRIGGER/MONITOR AMPLIFIER | INTERNAL TRIGGER COMPARATOR | TRIGGER STATUS FLIP FLOP

ASSEMBLY 13522
REFERENCE DESIGNATORS ARE ABBREVIATED
PREFIX WITH A6

RESET LIGHT 29
C1 68
C2 6.8pF
C37 .001
R1 49.9 1%
R2 1.54K 1%
U1 CA3030
R3 680
R4 100
C3 0.1
-12.6V
C4 470PF
R5 100
C7 0.1
C6 0.1
CR1 IN4148
R6 1K
+12.6V
R8 68K
R9 100
U2 710C
C9 0.1
R10 10K
R11 1K
R12 100K
C11 4.7PF
C10 .001
R15 2.2K
R16 2.2K
R17 10K
U3A
SN74LS10
+5V
R31 1K
U9 SN74LS74
RESET LIGHT DRIVER
R22 120
C14 0.1
R21 2.2K
Q1 2N3646
U9A
U9B
C15 .022
R23 33K
U4 SN74121 500MS ONE SHOT
C16 .022
R24 68K
U5 SN74121 1ms ONE SHOT
5 SEC DELAY
+5.0V
R26 4.7M
Q2 2N3569
R27 1K
Q3 2N3565
R28 4.7K
CR4 IN4148
Q4 2N3565
R30 100K
R25 4.7K
C17 2.7
R29 100K
C18 .01
8 ← 5 SEC RESET
17 ← DISPLAY TRIG (NON-AVG)
9 ← TO HOLD GATE
TO S4-D2 1
MONITOR OUTPUT 11 10
R7 47
T1
C5 12
CR2 IN4148
C12 0.1
R13 100
C13 0.1
R14 2.2K
CR5 IN4 148
R36 22K
C27 4.7
R32 47K
U6 SN74121 200ms ONE SHOT
C28 4.7
R33 2.2K
R34 2.2K
R82 100
9 ← DISPLAY TRIG (AVERAGE)
MANUAL TRIGGER RESET 26 25
R19 33K
R18 100K
R20 150K
+12.6V
CR3 IN4148
U3B
U3C
C19 .01
RESET DELAY
R80 100K
C25 100
CR13 IN4148
+5.0V
+12.6V
R52 1M
CR12 IN4148
U7 741C
Q11 2N4250
C26 .001
Q10 2N3569
R51 3.3K
C24 4.7
R54 47K
R55 1M
-12.6V
R56 2.2K
CR14 IN4148
R44 2.2K
U8 SN74121 1.5μs ONE SHOT
R57 10K
NEW DATA LIGHT DRIVER
+5V
R58 470K
R59 470K
Q14 2N3644
Q12 2N3565
C30 0.1
Q13 2N4250
R60 1K
R61 120
23 ← NEW DATA LIGHT
22 ← TRIGGER RESET RATE
20 ← MAX RESET SWITCH
6 ← TO SAMPLING TRIGGER
RESET TRIGGER AMPLIFIER
RESET TRIGGER INPUT 27 28
R35 4.7K
R37 1K
T2
Q5 2N3646
R38 100
CR6 IN4148
R39 4.7K
+5.0V
CR8 IN 4148
CR9 IN 4148
CR11 IN4148
R50 22K
+5V
R40 100K
R41 4.7K
TO S4-D3 2
TO S4-C 30
TRIGGER INPUT 4 3
T3
C36 .0047
R43 100
CR7 IN4148
R42 1K
Q6 2N3646
C20 .01
TRIG AMPLIFIER
CR15 IN4148
R66 4.02K 1%
R72 47K
R73 100K
Q21 2N3646
+12.6V
R62 33K
R63 4.7K
R76 47
C32 150PF
C33 .01
31
5
38
8
7
TRIGGER DELAY
R65 2.00K 1%
Q16 2N4250
Q18 2N4121
Q20 T1597
R75 100
R77 7.68K 1%
+12.6V
R67 8.25K 1%
Q19 T1597
R74 15K
C34 .001
C35 0.1
R78 200
R79 FACTORY SELECTED VALUE
DELAY ZERO
0-100μS DELAY
CAL FACTOR GROUND 35
R46 120
J1
TP61
+5V 32
+5.0V
C21 100
GROUND 16
C22 0.1
J2
TP62
-12.6V 14
R64 4.7K
R68 2.2K
R69 5K
Q15 2N4121
C29 10pF
DELAY CAL
-6.3V SUPPLY
Q9 2N3644
R48 6.81K 1%
R49 5.62K 1%
-6.3V
R70 1K
R71 22
C31 .022
Q17 2N3646
* R47
34 33 37 36
C23 220 PF
R64 4.7K

NOTE:
1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS AND ARE ±5% 1/4 W. CAPACITOR VALUE ARE IN MICROFARADS.
2. * DENOTES FACTORY SELECTED VALUE. USED WITH OPTIONS 05 AND 06 UNITS.
3. OPTION 05: C31 IS REMOVED; JUMPER BETWEEN A6-5 AND A6-38 IS REMOVED; A6-18 IS DISCONNECTED.

+5V 14 U3 7

ITEM	REQD	PART NO	DESCRIPTION

LIST OF MATERIAL

NEXT ASSY

FINISH OR TREATMENT

UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE
XX ± .015
XXX ± .005

SCALE

		DATE
DRAWN	Y O	2-9-77
ENG	RB	7-7-77
PROD		

PM PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO CALIFORNIA

TRIGGER CIRCUIT

DRAWING NO 13523 REV E

SHEET 1 OF 1

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PART NO.	TOT. QTY.
		3 DIGIT DISPLAY PC BOARD ASSY - 13342 (Refer to Fig. 7-8)		
A7C1	E-1	Cap, elect. 68µF 20% 15V	10787-4	2
A7C2	D-3	Cap, cer. 470pF 5% 1000V	10585-3	1
A7C3	D-3	Cap, cer. .001µF ±20% 100V	10000-4	2
A7C4	D-2	Cap, cer. 0.1µF +80% -20% 100V	10000-10	2
A7C5	C-2	Cap, cer. 470pF 20% 1000V	10000-3	1
A7C6	A-2	Cap, cer. .01µF 20% 100V	10000-11	5
A7C7	C-2	Cap, cer. .01µF 20% 100V	10000-11	Ref
A7C8	D-2	Cap, cer. 0.1µF +80% -20% 100V	10000-10	Ref
A7C9	C-2	Cap, cer. .01µF 20% 100V	10000-11	Ref
A7C10	C-3	Cap, cer. .001µF 20% 100V	10000-4	Ref
A7C11	C-2	Cap, cer. .01µF 20% 100V	10000-11	Ref
A7C12	B-3	Cap, elect. 68µF 20% 15V	10787-4	Ref
A7C13	D-3	Cap, cer. 220pF 20% 1000V	10000-2	1
A7C14	*	Cap, cer. .01µF ±20% 100V	10000-11	Ref
A7C15	*	Cap, cer. 100pF ±20% 1000V	10000-1	1
A7CR1	C-2	Diode, IN4148	10043	21
A7CR2	D-2	Diode, IN4148	10043	Ref
A7CR3	C-3	Diode, IN4148	10043	Ref
A7CR4	C-2	Diode, IN4148	10043	Ref
A7CR5	B-2	Diode, IN823	10045	1
A7CR6	B-3	Diode, IN4148	10043	Ref
A7CR7	B-3	Diode, IN4148	10043	Ref
A7CR8	A-3	Diode, IN4148	10043	Ref
A7CR9	A-3	Diode, IN4148	10043	Ref
A7CR10	C-4	Diode, IN4148	10043	Ref
A7CR11	C-4	Diode, IN4148	10043	Ref
A7CR12	C-4	Diode, IN4148	10043	Ref
A7CR13	C-4	Diode, IN4148	10043	Ref
A7CR14	B-4	Diode, IN4148	10043	Ref
A7CR15	B-4	Diode, IN4148	10043	Ref
A7CR16	B-4	Diode, IN4148	10043	Ref
A7CR17	B-4	Diode, IN4148	10043	Ref
A7CR18	B-4	Diode, IN4148	10043	Ref
A7CR19	B-4	Diode, IN4148	10043	Ref
A7CR20	A-4	Diode, IN4148	10043	Ref
A7CR21	A-4	Diode, IN4148	10043	Ref
A7CR22	A-4	Diode, IN4149	10043	Ref
A7J1	E-1	Test Jack, Red	10140-1	1
A7J2	E-1	Test Jack, Yellow	10140-2	3
A7J3	C-2	Test Jack, Yellow	10140-2	Ref
A7J4	C-3	Test Jack, Yellow	10140-2	Ref
A7J5	F-1	Test Jack, Black	10140-3	1
A7J6	C-6	Connector, 15 Pin PC Edge	13267-1	1
A7Q1	D-3	Transistor, 2N3646	10018	1
A7Q2	C-3	Transistor, 2N3646	10018	Ref

* Not Illustrated

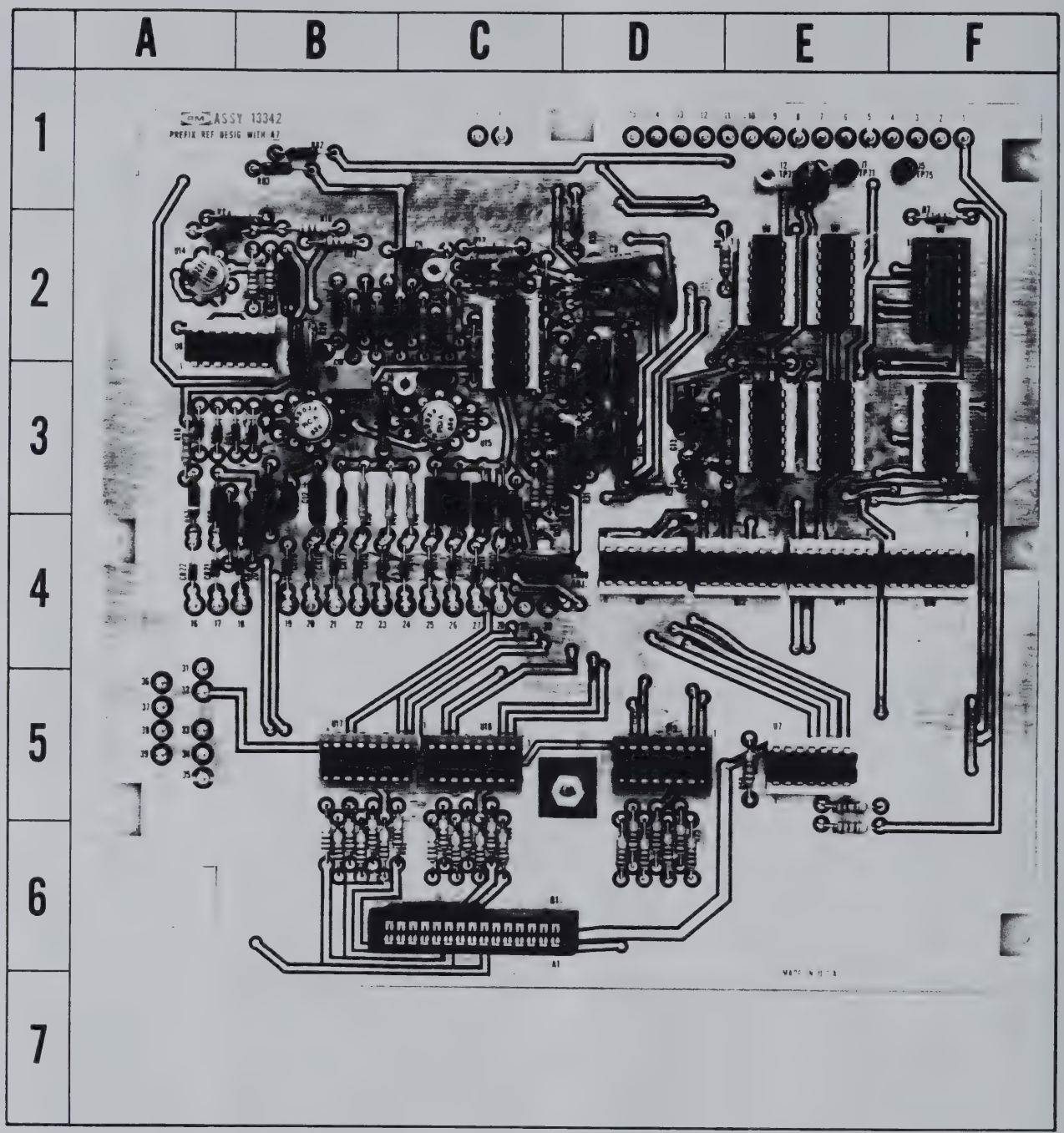
REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PMI PART NO.	TOT. QTY.
A7R1	D-3	Res, met flm 19.6KΩ 1% 1/4W	10015-60	1
A7R2	D-3	Res, car flm 10KΩ 5% 1/4W	10013-37	6
A7R3	D-3	Res, car flm 2.2KΩ 5% 1/4W	10013-29	3
A7R4	D-3	Res, car flm 2.2KΩ 5% 1/4W	10013-29	Ref
A7R5	A-2	Res, car flm 1KΩ 5% 1/4W	10013-25	7
A7R6	A-2	Res, car flm 10KΩ 5% 1/4W	10013-37	Ref
A7R7	F-2	Res, car flm 1KΩ 5% 1/4W	10013-25	Ref
A7R8	D-2	Res, car flm 1KΩ 5% 1/4W	10013-25	Ref
A7R9	E-5	Res, car flm 1KΩ 5% 1/4W	10013-25	Ref
A7R10	E-5	Res, car flm 1KΩ 5% 1/4W	10013-25	Ref
A7R11	C-2	Res, car flm 4.7KΩ 5% 1/4W	10013-33	2
A7R12	C-2	Res, met flm 10.00KΩ 1.0% 1/4W	12449-21	4
A7R13	C-2	Res, met flm 10.00KΩ 0.1% 1/4W	12449-21	Ref
A7R14	C-2	Res, car flm 10KΩ 5% 1/4W	10013-37	Ref
A7R15	B-2	Res, met flm 1.33KΩ 1% 1/4W	10015-75	1
A7R16	B-2	Res, car flm 100Ω 5% 1/4W	10013-13	4
A7R17	C-2	Res, car comp 47 Ω±5% 1/4 W	10142-8	2
A7R18	A-3	Res, car flm 330Ω 5% 1/4W	10013-19	3
A7R19	D-2	Res, met flm 10.00KΩ 0.1% 1/4W	12449-21	Ref
A7R20	B-2	Res, met flm 10.0KΩ 1% 1/4W	10015-7	2
A7R21	D-3	Res, var comp 100Ω 20% 1/4W	10046-9	1
A7R22	D-2	Res, met flm 10.00KΩ 0.1% 1/4W	12449-21	Ref
A7R23	C-2	Res, met flm 2.00KΩ 0.1% 1/4W	12449-51	1
A7R24	C-2	Res, met flm 10.0KΩ 1% 1/4W	10015-7	Ref
A7R25	B-2	Res, car comp 2.2MΩ 5% 1/4W	10013-65	2
A7R26	B-2	Res, car flm 100Ω 5% 1/4W	10013-13	Ref
A7R27	B-2	Res, met flm 1.24KΩ 1% 1/4W	10015-77	1
A7R28	C-3	Res, car flm 4.7KΩ 5% 1/4W	10013-33	Ref
A7R29	C-3	Res, car flm 100Ω 5% 1/4W	10013-13	Ref
A7R30	C-3	Res, car comp 2.2MΩ 5% 1/4W	10013-65	Ref
A7R31	C-3	Res, car flm 10KΩ 5% 1/4W	10013-37	Ref
A7R32	C-3	Res, car flm 470Ω 5% 1/4W	10013-21	1
A7R33	C-3	Res, car flm 2.2KΩ 5% 1/4W	10013-29	Ref
A7R34	C-3	Res, car flm 22KΩ 5% 1/4W	10013-41	1
A7R35	C-2	Res, car flm 10KΩ 5% 1/4W	10013-37	Ref
A7R36	C-3	Res, car flm 1KΩ 5% 1/4W	10013-25	Ref
A7R37	B-2	Res, car flm 100Ω 5% 1/4W	10013-13	Ref
A7R38	D-3	Res, var comp 100KΩ 20% 1/4W	10046-10	2
A7R39	B-2	Res, var comp 100KΩ 20% 1/4W	10046-10	Ref
A7R40	B-2	Res, met flm 806Ω 1% 1/4W	10015-154	1
A7R41	B-3	Res, var comp 500Ω 20% 1/4W	11711-1	1
A7R42	B-2	Res, met flm 3.01KΩ 1% 1/4W	10015-110	1
A7R43	B-3	Res, met flm 3.83KΩ 1% 1/4W	10015-32	1
A7R44	C-3	Res, met flm 3.966KΩ 0.1% 1/4W	12449-56	1
A7R45	C-3	Res, WW 4.9588KΩ .01% 1/4W	11695-16	1
A7R46	C-3	Res, WW 9.945KΩ .01% 1/4W	11695-17	1
A7R47	C-3	Res, WW 19.935KΩ .01% 1/4W	11695-18	1
A7R48	C-3	Res, met flm 39.96KΩ 0.1% 1/4W	12449-52	1
A7R49	B-3	Res, met flm 50.00KΩ 0.1% 1/4W	12449-53	1
A7R50	B-3	Res, met flm 100KΩ 0.1% 1/4W	12449-33	1
A7R51	B-3	Res, met flm 200KΩ 0% 1/4W	10015-62	1
A7R52	B-3	Res, met flm 402KΩ 1% 1/4W	10015-63	1
A7R53	B-2	Res, met flm 499KΩ 1% 1/4W	10015-45	3
A7R54	A-4	Res, met flm 499KΩ 1% 1/4W	10015-45	Ref

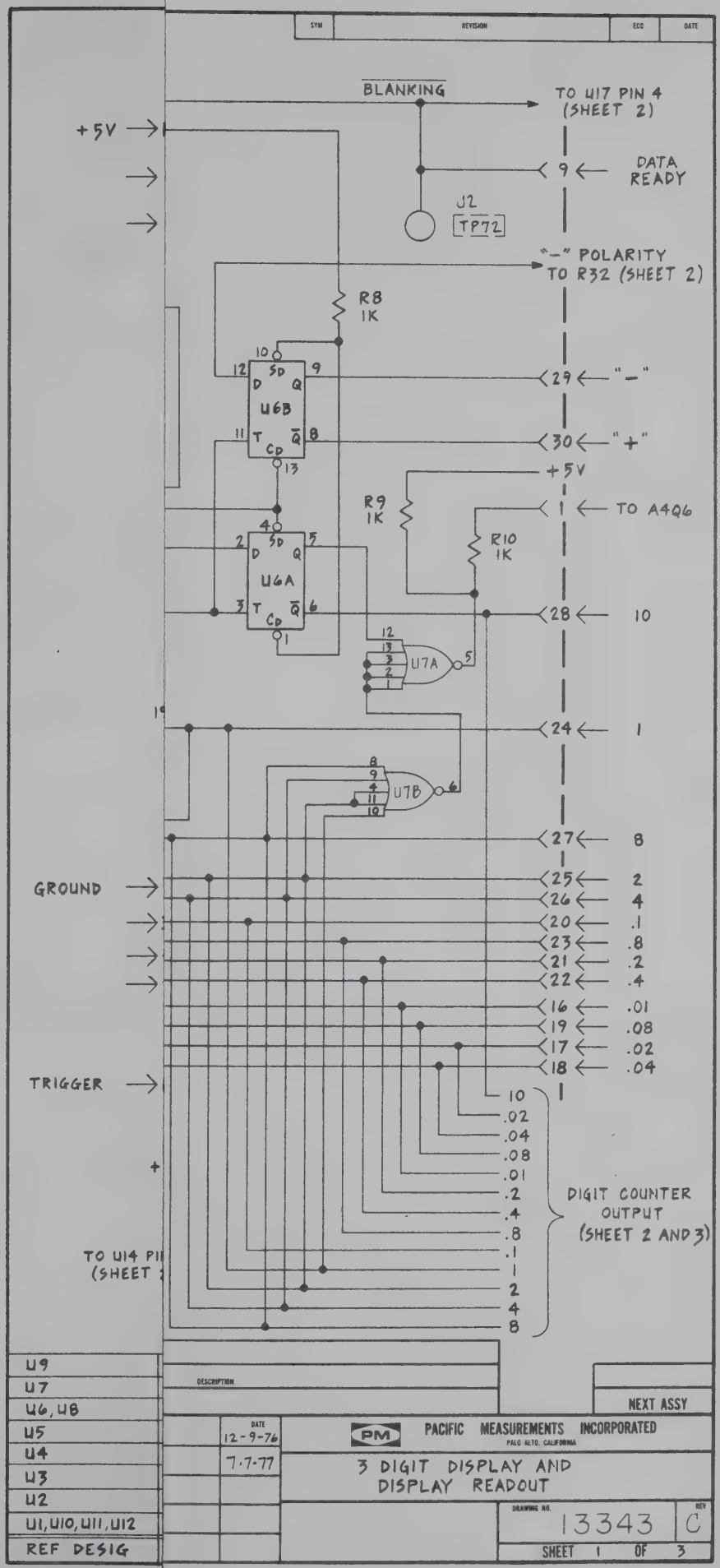
REPLACEABLE PARTS LIST

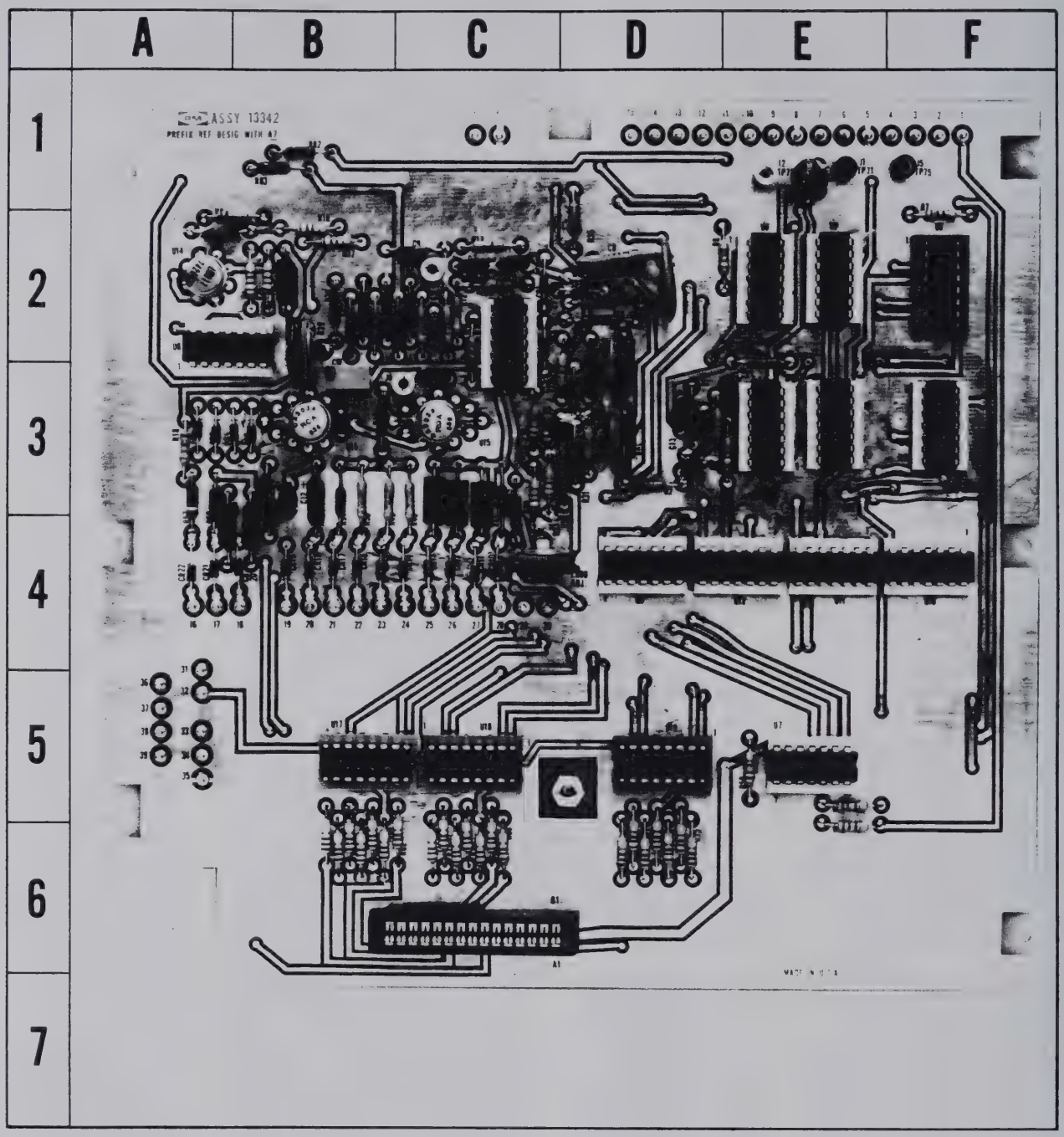
REF. DESIG.	LOCA-TION	DESCRIPTION	DM PART NO.	TOT. QTY.
A7R55	A-4	Res, met flm 499KΩ 1% 1/4W	10015-45	Ref
A7R56	A-3	Res, car comp 2MΩ 5% 1/4W	10013-74	2
A7R57	A-3	Res, car comp 3.9MΩ 5% 1/4W	10013-68	1
A7R58	D-2	Res, car comp 47 Ω±5% 1/4 W	10142-8	Ref
A7R59	E-5	Res, car flm 1KΩ 5% 1/4W	10013-25	Ref
A7R60	B-6	Res, car flm 390Ω 5% 1/4W	10013-20	21
A7R61	B-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R62	B-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R63	B-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R64	B-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R65	B-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R66	B-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R67	C-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R68	C-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R69	C-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R70	C-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R71	C-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R72	C-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R73	C-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R74	D-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R75	D-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R76	D-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R77	D-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R78	D-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R79	D-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R80	D-6	Res, car flm 390 Ω 5% 1/4W	10013-20	Ref
A7R81	E-2	Res, car flm 330Ω 5% 1/4W	10013-19	Ref
A7R82	B-1	Res, met flm 4.00KΩ 0.1% 1/4W	12449-55	1
A7R83	B-1	Res, met flm 1.33KΩ 0.1% 1/4W	12449-54	1
A7R84	C-4	Res, var comp 250KΩ 20% 1/4W	10046-11	1
A7R85	C-4	Res, car flm 2MΩ 5% 1/4W	10013-74	Ref
A7R86	*	Res, car flm 10KΩ 5% 1/4W	10013-37	Ref
A7R87	*	Res, car flm 330Ω 5% 1/4W	10013-19	Ref
A7U1	E-3	IC, SN74LS90N	13470-15	4
A7U2	E-2	IC, SN74LS107N	13470-16	1
A7U3	F-2	IC, SN74LS42N	13470-12	1
A7U4	E-3	IC, SN74LS00N	13470-1	1
A7U5	F-3	IC, SN74LS04N	13470-4	1
A7U6	E-2	IC, SN74LS74N	13470-13	2
A7U7	E-5	IC, SN74S260N	13473-1	1
A7U8	B-2	IC, SN74LS74N	13470-13	Ref
A7U9	D-4	IC, SN74LS27N	13470-9	1
A7U10	F-4	IC, SN74LS90N	13470-15	Ref
A7U11	E-4	IC, SN74LS90N	13470-15	Ref
A7U12	E-4	IC, SN74LS90N	13470-15	Ref
A7U13	C-2	IC, LM324N	13471	1
A7U14	A-2	IC, LM311H	11691	1
A7U15	C-3	IC, CA3039 (Matched Pair)	11118-3	1
A7U16	B-3	IC, CA3039 (Matched Pair)	11118-3	Ref
A7U17	B-5	IC, SN74LS247N	13470-19	3
A7U18	C-5	IC, SN74LS247N	13470-19	Ref
A7U19	D-5	IC, SN74LS247N	13470-19	Ref
		Socket, IC, 14 Pin	10978-1	12
		Socket, IC, 16 Pin	10978-2	4

* Not Illustrated



DIGITAL DISPLAY BOARD ASSEMBLY
FIGURE 7-8


SYM
REVISION
ECO
DATE
BLANKING
TO U17 PIN 4 (SHEET 2)
+5V
9 ← DATA READY
J2
TP72
"-" POLARITY TO R32 (SHEET 2)
R8 1K
U6B
29 ← "-"
30 ← "+"
+5V
R9 1K
R10 1K
1 ← TO A4Q6
U6A
28 ← 10
U7A
24 ← 1
U7B
27 ← 8
GROUND
25 ← 2
26 ← 4
20 ← .1
23 ← .8
21 ← .2
22 ← .4
16 ← .01
19 ← .08
17 ← .02
18 ← .04
TRIGGER
10
.02
.04
.08
.01
.2
.4
.8
.1
1
2
4
8
DIGIT COUNTER OUTPUT (SHEET 2 AND 3)
TO U14 PI
(SHEET
U9
U7
U6, U8
U5
U4
U3
U2
U1, U10, U11, U12
REF DESIG
DESCRIPTION
NEXT ASSY
DATE
12-9-76
7-7-77
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA
3 DIGIT DISPLAY AND DISPLAY READOUT
DRAWING NO.
13343
REV
C
SHEET 1 OF 3



DIGITAL DISPLAY BOARD ASSEMBLY
FIGURE 7-8

ASSEMBLY 13342
REFERENCE DESIGNATORS ARE ABBREVIATED
PREFIX WITH A7

SYM	REVISION	ECO	DATE

J1 TP71

+5V → 13
→ 6
→ 7

C1 68

R7 1K

U1 U2 U3

U4A U4B U4C U4D

R87 330

U5A U5B U5C U5D U5E

C15 100 PF

TO U8 PIN 1

BLANKING → TO U17 PIN 4 (SHEET 2)

9 ← DATA READY

J2 TP72

"−" POLARITY TO R32 (SHEET 2)

R8 1K

U6A U6B

29 ← "−"

30 ← "+"

+5V

R9 1K R10 1K

1 ← TO A4Q6

28 ← 10

U7A U7B

24 ← 1

27 ← 8

25 ← 2

26 ← 4

20 ← .1

23 ← .8

21 ← .2

22 ← .4

16 ← .01

19 ← .08

17 ← .02

18 ← .04

R1 19.6 K 1%

R2 10K

R3 2.2K

C3 .001

RB6 10K

Q1 2N3646

1MS +10μS

R4 2.2K

RB1 330

C2 470 pF

C13 220PF

U9A U9B U9C

U10 U11 U12

GROUND → 8
→ 35
→ 40
→ 5

TRIGGER → 15

U8A

RESET

$\overline{\text{RESET}}$

TO U3 PIN 5

+5V

R5 1K

R6 10K

U8B

TO U14 PIN 7 (SHEET 2) (COMPARATOR)

U4 U5 U6 U7 U8 U9

J5 TP75

10
.02
.04
.08
.01
.2
.4
.8
.1
1
2
4
8

DIGIT COUNTER OUTPUT (SHEET 2 AND 3)

REF DESIG	TYPE
U1, U10, U11, U12	SN74LS90N
U2	SN74LS107N
U3	SN74LS42N
U4	SN74LS00N
U5	SN74LS04N
U6, U8	SN74LS74N
U7	SN74S260
U9	SN74LS27N

NOTE:
1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS AND ARE ± 5% 1/4 W. CAPACITOR VALUES ARE IN MICROFARADS.

ITEM	REQD	PART NO	DESCRIPTION

LIST OF MATERIAL

NEXT ASSY

FINISH OR TREATMENT

UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE
XX - .015
XXX - .005

SCALE

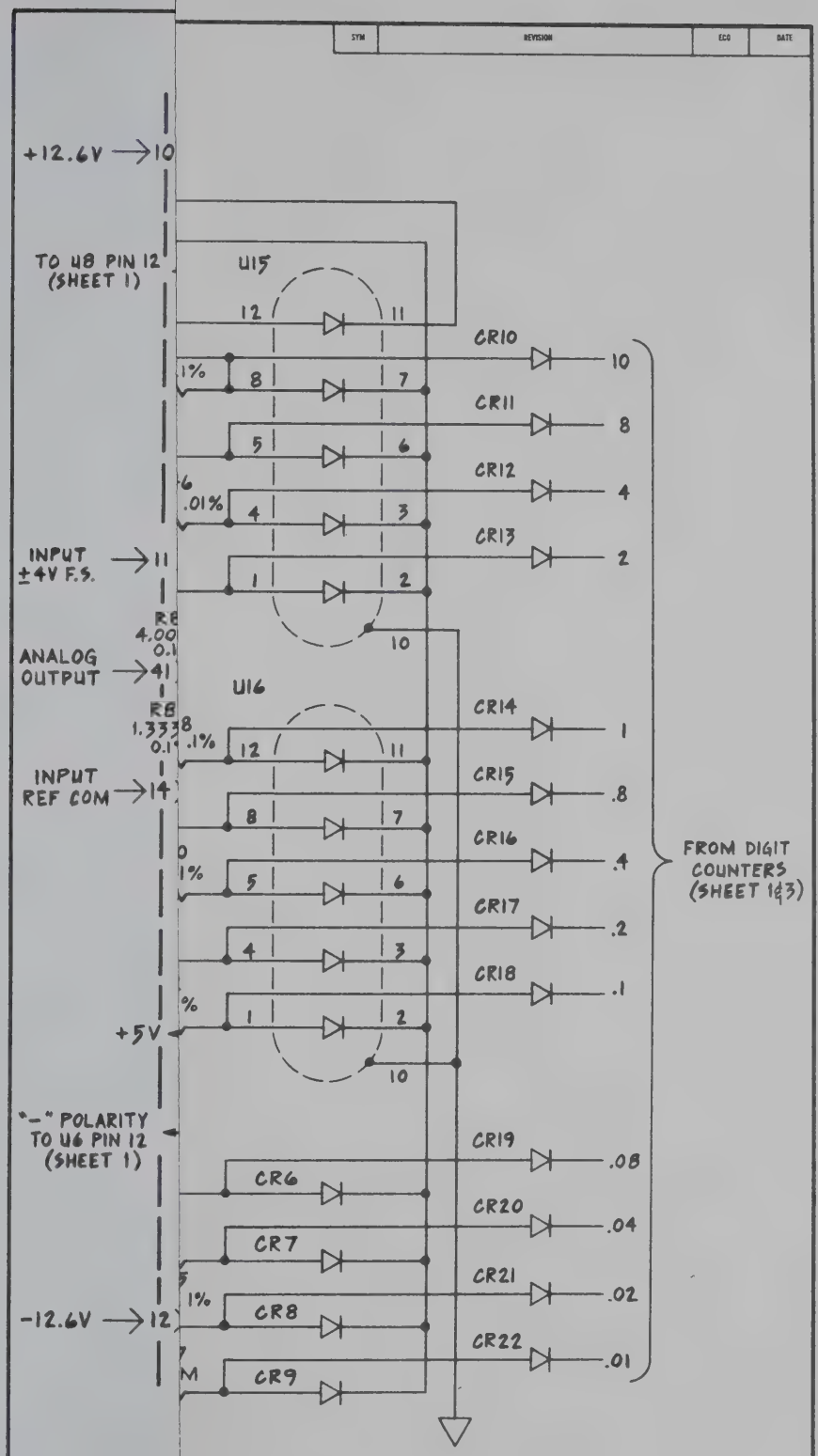
		DATE
DRAWN	JS	12-9-76
ENG	RB	7-7-77
PROD		

PM PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO CALIFORNIA

3 DIGIT DISPLAY AND DISPLAY READOUT

DRAWING NO 13343 REV C

SHEET 1 OF 3


SYM
REVISION
ECO
DATE
+12.6V → 10
TO U8 PIN 12 (SHEET 1)
U15
12
11
CR10
10
1%
8
7
CR11
8
5
6
CR12
4
.01%
4
3
CR13
2
INPUT ±4V F.S. → 11
1
2
10
ANALOG OUTPUT → 41
U16
CR14
1
.1%
12
11
INPUT REF COM → 14
CR15
.8
8
7
CR16
.4
1%
5
6
CR17
.2
4
3
CR18
.1
%
1
2
+5V
10
"-" POLARITY TO U6 PIN 12 (SHEET 1)
CR19
.08
CR6
CR20
.04
CR7
CR21
.02
1%
CR8
-12.6V → 12
CR22
.01
M
CR9
FROM DIGIT COUNTERS (SHEET 1&3)
DESCRIPTION
NEXT ASSY
U15, U16
CA3
MAT
PA
DATE
12-9-76
7-7-77
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA
U14
LM
U13
LM
REF DESIG
TY
3 DIGIT DISPLAY AND DISPLAY READOUT
DRAWING NO
13343
REV
A
SHEET 2 OF 3

ASSEMBLY 13342
REFERENCE DESIGNATORS ARE ABBREVIATED
PREFIX WITH A7

+12.6V → 10
C4 0.1
TO U8 PIN 12 (SHEET 1)
(COMPARATOR OUTPUT)
TP73 J3
R11 4.7K
R12 10.00K 0.1%
R13 10.00K 0.1%
R15 1.33K 1%
R14 10K
R16 100
R17 47
R18 330
C5 470 pF
+1.3V TO -2.7V
C6 .01
C7 .01
CR1
CR2
U13A
U13B
U14
R23 2.00K 0.1%
R26 100
+1.3V
INPUT ±4V F.S. → 11
R82 4.000K 0.1%
R19 10.00K 0.1%
+.65V
R24 10.0K 1%
J4 TP74
+1.3V
1.000 ADJ.
R85 2M
R84 250K
ANALOG OUTPUT → 41
R83 1.333K 0.1%
R20 10.0K 1%
R21 100
R22 10.00K 0.1%
R25 2.2M
R27 1.24K 1%
INPUT REF COM → 14
*
-F.S.
CR3
CR4
R41 500
+F.S.
C10 .001
U13C
U13D
+9.9V
*
+BAL
R39 100K
R28 4.7K
R29 100
R30 2.2M
R38 100K
*
-BAL
CR5 IN823
R42 3.01K 1%
R40 806 1%
-5V
+5V
R31 10K
R32 470
R35 10K
"-" POLARITY TO U6 PIN 12 (SHEET 1)
Q2 2N3646
R36 1K
R37 100
C9 .01
R33 2.2K
R34 22K
C12 68
-12.6V → 12
C8 0.1
R58 47
C11 .01

U15
R43 3.83K 1%
R44 3.966K 1%
R45 4.9588K .01%
R46 9.945K .01%
R47 19.935K .01%
CR10 → 10
CR11 → 8
CR12 → 4
CR13 → 2

U16
R48 39.96K .1%
R49 50.00K .1%
R50 100K .1%
R51 200K 1%
R52 402K 1%
CR14 → 1
CR15 → .8
CR16 → .4
CR17 → .2
CR18 → .1

R53 499K 1%
R54 499K 1%
R56 2.0M
R55 499K 1%
R57 3.9M
CR6
CR7
CR8
CR9
CR19 → .08
CR20 → .04
CR21 → .02
CR22 → .01

FROM DIGIT COUNTERS (SHEET 1&3)

NOTES:

1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS AND ARE ±5% 1/4W. CAPACITOR VALUES ARE IN MICROFARADS.
2. ALL DIODES ARE IN4148 UNLESS SPECIFIED OTHERWISE.
3. * ADJUST +BAL AND +F.S. BEFORE -BAL AND -F.S.
4. ** REMOVE SERIES COMPONENTS IN MODEL 1018A, CONNECT DIRECT TO 74121'S.

REF DESIG	TYPE
U13	LM324
U14	LM311
U15, U16	CA3039 [MATCH PAIR]

SYM	REVISION	ECO	DATE

ITEM	REQD	PART NO	DESCRIPTION

LIST OF MATERIAL

NEXT ASSY

FINISH OR TREATMENT

UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE
.XX ± .015
.XXX ± .005

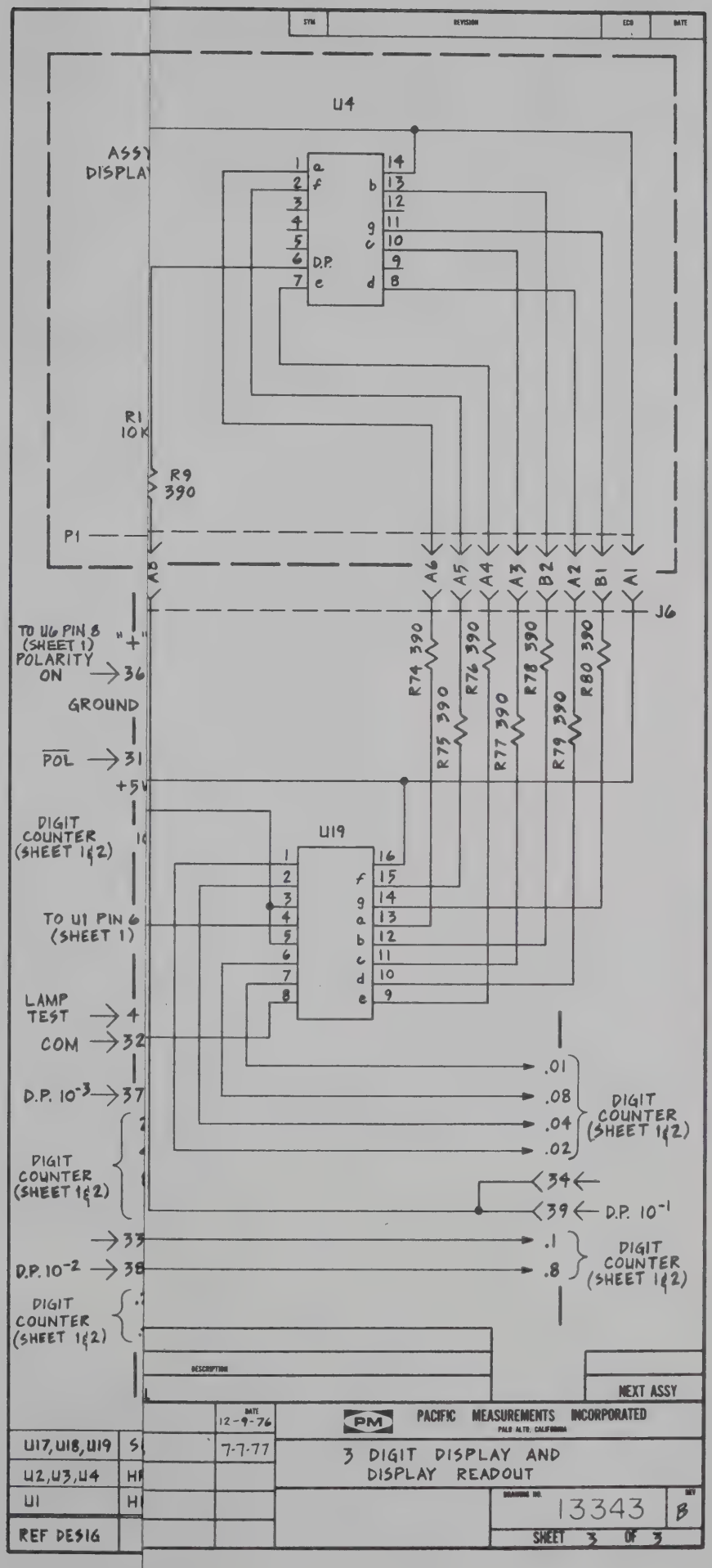
SCALE

DRAWN J.S. 12-9-76
ENG RB 7-7-77
PROD

PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO CALIFORNIA

3 DIGIT DISPLAY AND DISPLAY READOUT

DRAWING NO. 13343 REV A
SHEET 2 OF 3


SYM
REVISION
ECO
DATE
U4
ASSY DISPLAY
a
f
b
g
c
D.P.
e
d
14
13
12
11
10
9
8
R1 10K
R9 390
P1
A6
A5
A4
A3
B2
A2
B1
A1
J6
R74 390
R75 390
R76 390
R77 390
R78 390
R79 390
R80 390
TO U6 PIN 8 (SHEET 1)
POLARITY ON → 36
GROUND
POL → 31
+5V
DIGIT COUNTER (SHEET 1&2)
U19
TO U1 PIN 6 (SHEET 1)
LAMP TEST → 4
COM → 32
D.P. 10⁻³ → 37
.01
.08
.04
.02
DIGIT COUNTER (SHEET 1&2)
34
39 ← D.P. 10⁻¹
33
D.P. 10⁻² → 38
.1
.8
DIGIT COUNTER (SHEET 1&2)
DESCRIPTION
NEXT ASSY
DATE
12-9-76
7-7-77
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA
U17, U18, U19
U2, U3, U4
U1
REF DESIG
3 DIGIT DISPLAY AND DISPLAY READOUT
13343
B
SHEET 3 OF 3

A11
ASSY 13345
DISPLAY READOUT

U1 U2 U3 U4

R3 180 R5 220 R4 390 R1 10K R2 10K R6 10K R7 390 R8 390 R9 390

Q1 2N3569 Q2 2N3569 Q3 2N 3569

P1

B15 A14 A15 B14 A7 A13 B13 B12 A12 B11 A11 B10 A10 A9 B9 B8 B7 B6 B5 B4 B3 A8 A6 A5 A4 A3 B2 A2 B1 A1 J6

R60 390 R61 390 R62 390 R63 390 R64 390 R65 390 R66 390 R67 390 R68 390 R69 390 R70 390 R71 390 R72 390 R73 390 R74 390 R75 390 R76 390 R77 390 R78 390 R79 390 R80 390

TO U6 PIN 8 (SHEET 1) POLARITY ON → 36 "+" "−"

GROUND

$\overline{POL}$ → 31

+5V

DIGIT COUNTER (SHEET 1&2) 10

R59 1K

U17 U18 U19

TO U1 PIN 6 (SHEET 1)

$\overline{BLANKING}$

LAMP TEST → 4

COM → 32

D.P. 10^{-3} → 37

DIGIT COUNTER (SHEET 1&2) 2 4 8 1

→ 33

D.P. 10^{-2} → 38

DIGIT COUNTER (SHEET 1&2) .2 .4

C14 .01

.01 .08 .04 .02 DIGIT COUNTER (SHEET 1&2)

34 ←

39 ← D.P. 10^{-1}

.1 .8 DIGIT COUNTER (SHEET 1&2)

ASSEMBLY 13342
REFERENCE DESIGNATORS ARE ABBREVIATED PREFIX WITH A7

NOTE:
1. UNLESS SPECIFIED OTHERWISE, RESISTOR VALUES ARE IN OHMS AND ARE ±5% 1/4 W.

REF DESIG	TYPE
U17, U18, U19	SN74LS247N
U2, U3, U4	HP5082-7650
U1	HP5082-7652

ITEM	REQD	PART NO	DESCRIPTION

LIST OF MATERIAL

NEXT ASSY

FINISH OR TREATMENT

UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE
XX ± .015
XXX ± .005

SCALE

DRAWN J.S. 12-9-76
ENG RB 7-7-77
PROD

PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA

3 DIGIT DISPLAY AND DISPLAY READOUT

DRAWING NO. 13343 REV B

SHEET 3 OF 3

REPLACEABLE PARTS LIST

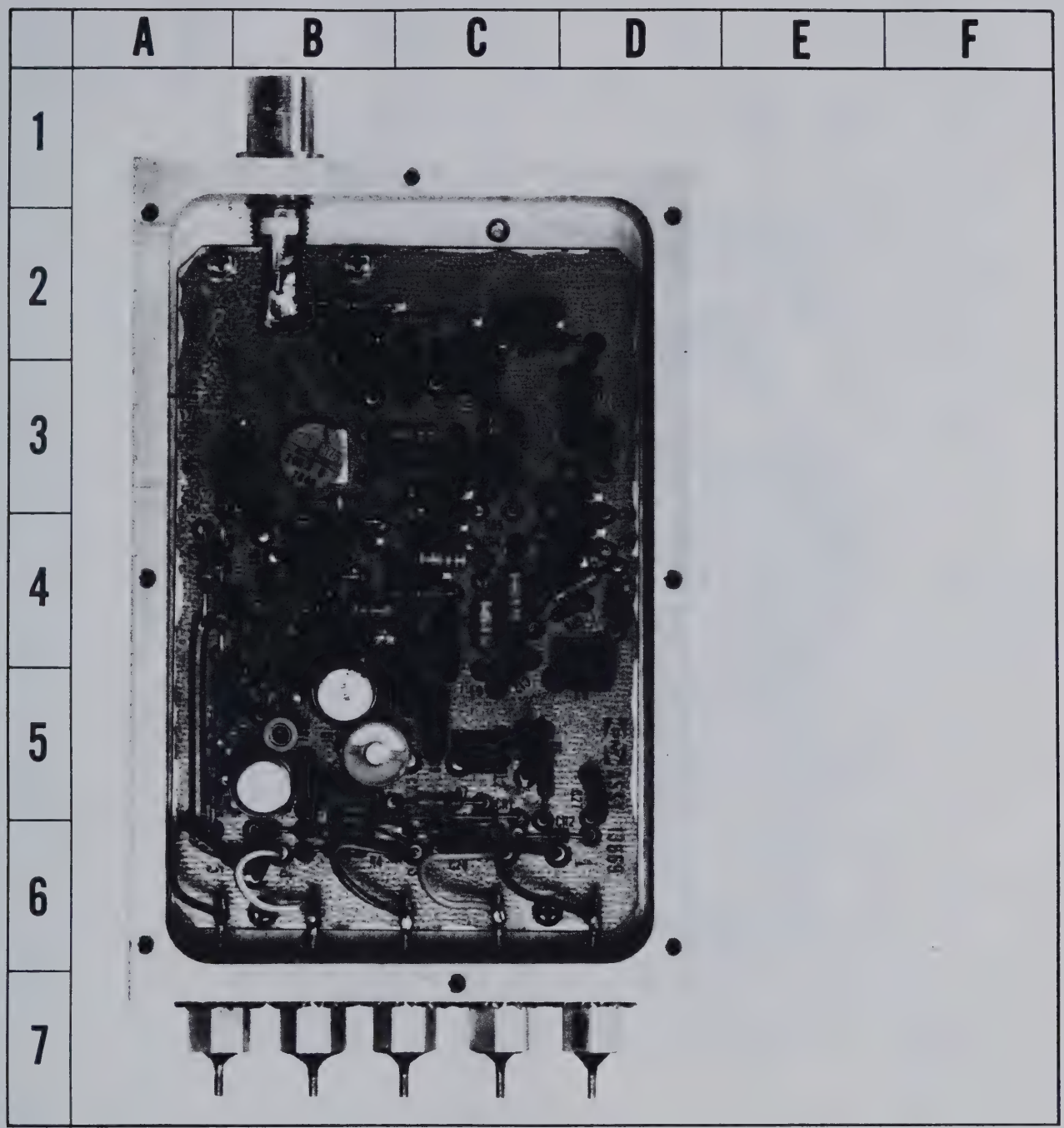
REF. DESIG.	LOCATION	DESCRIPTION	PART NO.	TOT. QTY.
		CALIBRATOR OSCILLATOR ASSEMBLY - 13694 (Refer to Fig. 7-9 and 7-10)		
A8FL1	D-7	Cap, Feedthru 1000 pF 20% 500V	10818-1	5
A8FL2	C-7	Cap, Feedthru 1000 pF 20% 500V	10818-1	Ref
A8FL3	C-7	Cap, Feedthru 1000 pF 20% 500V	10818-1	Ref
A8FL4	B-7	Cap, Feedthru 1000 pF 20% 500V	10818-1	Ref
A8FL5	A-7	Cap, Feedthru 1000 pF 20% 500V	10818-1	Ref
A8J1	B-1	Connector, BNC UG1094/U	10048	1
	C-4	Cal Oscillator PC Board Assy (Refer to Fig. 7-10)	13669	1
A8C1	D-3	Cap, cer,.01 µF ±20% 100V	10000-11	5
A8C2	C-2	Cap, cer, .01 µF ±20% 100V	10000-11	Ref
A8C3	D-2	Cap, cer, 47 pF ±5% 1000V	10001-6	1
A8C4	D-3	Cap, cer, .001 µF ±20% 1000V	10000-4	14
A8C5	C-4	Cap, cer, .001 µF ±20% 1000V	10000-4	Ref
A8C6	C-3	Cap, cer, .001 µF ±20% 1000V	10000-4	Ref
A8C7	C-3	Cap, variable, 2-8 pF NPO	10630-1	1
A8C8	B-2	Cap, cer .0022 µF ±20% 500V	10000-5	5
A8C9	C-3	Cap, mica, 68 pF ±5% 500V	10677-7	2
A8C10	C-3	Cap, mica, 68 pF ±5% 500V	10677-7	Ref
A8C11	C-3	Cap, mica 220 pF ±5% 500V	10677-2	1
A8C12	B-3	Cap, cer, .001 µF ±20% 1000V	10000-4	Ref
A8C14	C-4	Cap, cer, .001 µF ±20% 1000V	10000-4	Ref
A8C15	B-5	Cap, cer, .01 µF ±20% 100V	10000-11	Ref
A8C16	C-4	Cap, cer, 100 pF ±20% 1000V	10000-1	4
A8C17	D-5	Cap, cer, .001 µF ±20% 1000V	10000-4	Ref
A8C18	A-4	Cap, cer, .001 µF ±20% 1000V	10000-4	Ref
A8C19	A-4	Cap, cer, .001 µF ±20% 1000V	10000-4	Ref
A8C20	A-5	Cap, cer, 100 pF ±20% 1000V	10000-1	Ref
A8C21	C-4	Cap, cer, .001 µF ±20% 1000V	10000-4	Ref
A8C22	B-5	Cap, cer, .001 µF ±20% 1000V	10000-4	Ref
A8C23	A-5	Cap, cer, .001 µF ±20% 1000V	10000-4	Ref
A8C24	B-7	Cap, mica, 27 pF ±5% 1000V	10001-19	1
A8C25	C-6	Cap, mica, 43 pF ±5% 500V	10677-16	1
A8C26	C-6	Cap, cer, 22pF ±5% 1000V	10001-4	1
A8C27	*	Cap, cer, .01 µF ±20% 100V	10000-11	Ref
A8C28	*	Cap, cer 100 pF ±20% 1000V	10000-1	Ref
A8C29	*	Cap, cer, 100 pF ±20% 1000V	10000-1	Ref
A8C30	*	Cap, cer, 10 pF ±5% 1000V	10001-3	1
A8CR1	B-2	Diode, 1N4148	10043	2
A8CR2	A-2	Diode, 1N4148	10043	Ref
A3CR3	B-4	Diode, HPA 5082-3188	13687	4
A8CR4	B-4	Diode, HPA 5082-3188	13687	Ref
A8CR5	B-5	Diode, HPA 2900	11345	2
A8CR6	A-4	Diode, HPA 5082-3188	13687	Ref
A8CR7	A-4	Diode, HPA 5082-3188	13687	Ref
A8CR8	A-5	Diode, HPA 5082-2900	11345	Ref

*Not Illustrated

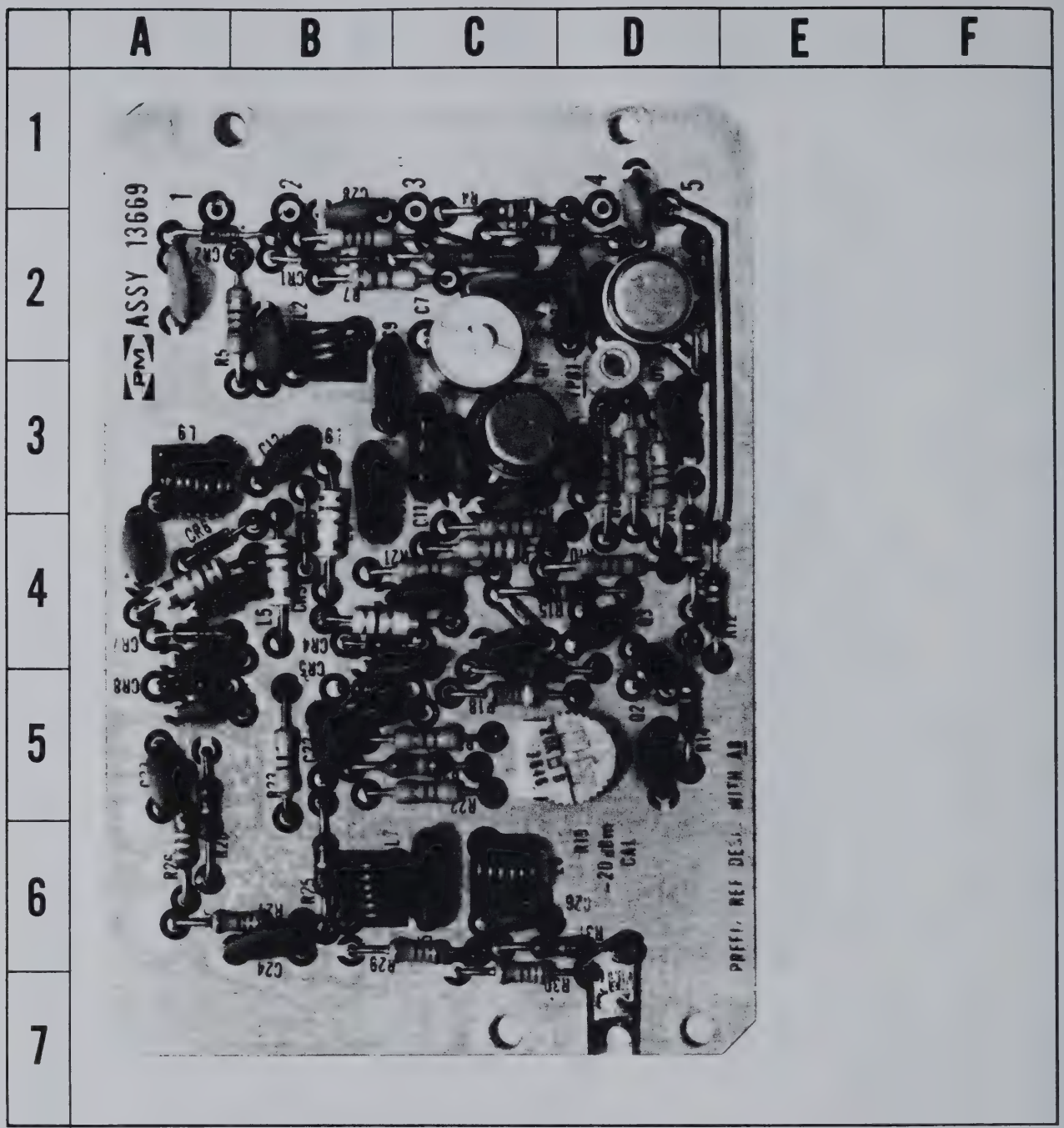
©

REPLACEABLE PARTS LIST

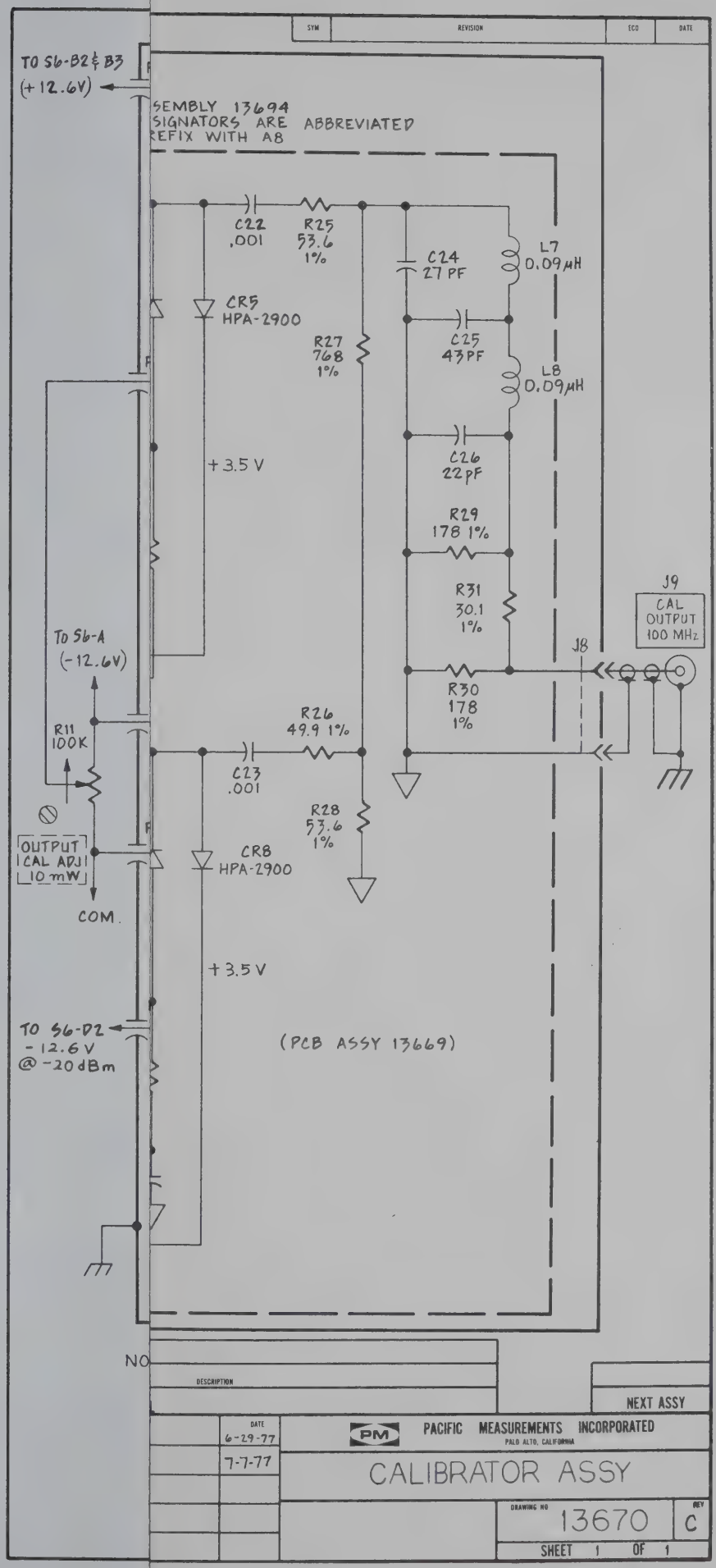
REF. DESIG.	LOCATION	DESCRIPTION	HP PART NO.	TOT. QTY.
A8L1		Not Used		
A8L2	B-2	Coil, RF .06μH	13689	1
A8L3	B-4	Coil, RF 4.7 μH	10631-15	Ref
A8L4	C-4	Coil, RF 4.7 μH	10631-15	Ref
A8L5	B-4	Coil, RF 4.7 μH	10631-15	Ref
A8L6	A-4	Coil, RF 4.7 μH	10631-15	Ref
A8L7	C-6	Coil, RF .09μH	13793	2
A8L8	C-6	Coil, RF .09μH	13793	Ref
A8L9	C-4	Coil, RF .14μH	14219	1
A8Q1	C-3	Transistor, 2N4427	12159	1
A8Q2	D-5	Transistor, 2N4250	11119	2
A8Q3	D-4	Transistor, 2N4250	11119	Ref
A8R1	B-2	Res, car. flm, 1MΩ ±5% 1/4W	10013-61	1
A8R2	C-2	Res, met. flm, 261 KΩ ±1% 1/4W	10015-219	1
A8R3	D-2	Res, car. flm, 10 KΩ±5% 1/4W	10013-37	4
A8R4	C-2	Res, car. flm, 47 KΩ ±5% 1/4W	10013-45	1
A8R5	B-2	Res, car. flm, 15 Ω ±5% 1/4W	10013-3	1
A8R6	E-2	Res, car. comp 47 Ω±5% 1/4W	10142-8	2
A8R7	C-2	Res, car. comp 47 Ω±5% 1/4W	10142-8	Ref
A8R8	D-3	Res, car. flm, 220 Ω±5% 1/4W	10013-17	3
A8R9	C-4	Res, car. flm, 270 Ω ±5% 1/4W	10013-18	1
A8R10	D-4	Res, car. flm, 220 Ω ±5% 1/4W	10013-17	1
A8R11	D-4	Res, car. flm, 4.7 KΩ ±5% 1/4W	10013-33	1
A8R12	E-4	Res, car. flm, 22 KΩ ±5% 1/4W	10013-41	1
A8R13	D-3	Res, car. flm, 120 Ω ±5% 1/4W	10013-14	1
A8R14	D-5	Res, car. flm, 10 KΩ±5% 1/4W	10013-37	Ref
A8R15	D-4	Res, car. flm, 10 KΩ ±5% 1/4W	10013-37	Ref
A8R16	D-3	Res, car. flm, 3.3 KΩ±5% 1/4W	10013-31	1
A8R17	C-5	Res, car. flm, 10 KΩ±5% 1/4W	10013-37	Ref
A8R18	C-5	Res, met. flm, 69.8 KΩ±1% 1/4W	10015-120	1
A8R19	D-5	Res, variable 20 KΩ± 1% 1/4W	13300-3	1
A8R20	C-5	Res, met. flm (Factory Selected Value)	-	
A8R21	C-4	Res, car. flm, 470 Ω ±5% 1/4W	10013-21	4
A8R22	C-5	Res, car. flm, 470 Ω±5% 1/4W	10013-21	Ref
A8R23	B-5	Res, car. flm, 470 Ω±5% 1/4W	10013-21	Ref
A8R24	C-5	Res, car. flm, 470 Ω±5% 1/4W	10013-21	Ref
A8R25	B-6	Res, met. flm, 53.6Ω ±1% 1/4W	10015-129	2
A8R26	A-6	Res, met. flm, 49.9 Ω ±1% 1/4W	10015-3	1
A8R27	B-6	Res, met. flm, 768 Ω ±1% 1/4W	10015-205	1
A8R28	A-6	Res, met. flm, 53.6 Ω ±1% 1/4W	10015-129	Ref
A8R29	C-6	Res, met. flm, 178 Ω ±1% 1/4W	10015-246	2
A8R30	B-7	Res, met. flm, 178 Ω ±1% 1/4W	10015-246	Ref
A8R31	D-6	Res, met. flm, 30.1 Ω±1% 1/4W	10015-76	1
A8R32		Res, car. flm, 220Ω±5% 1/4W	10013-17	1
A8U1		Integrated Circuit 741C	11539	1

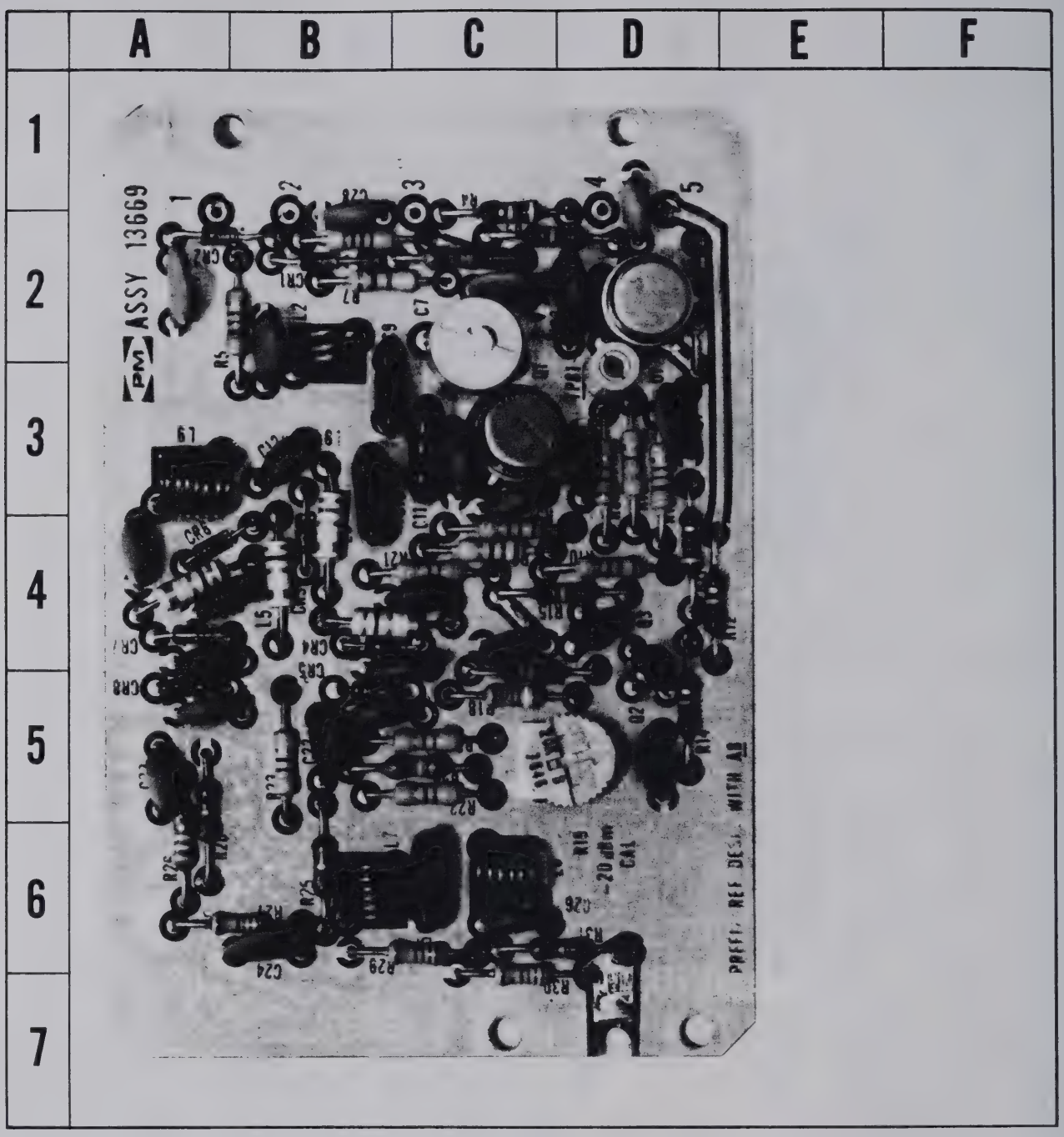


CALIBRATOR OSCILLATOR
FIGURE 7-9

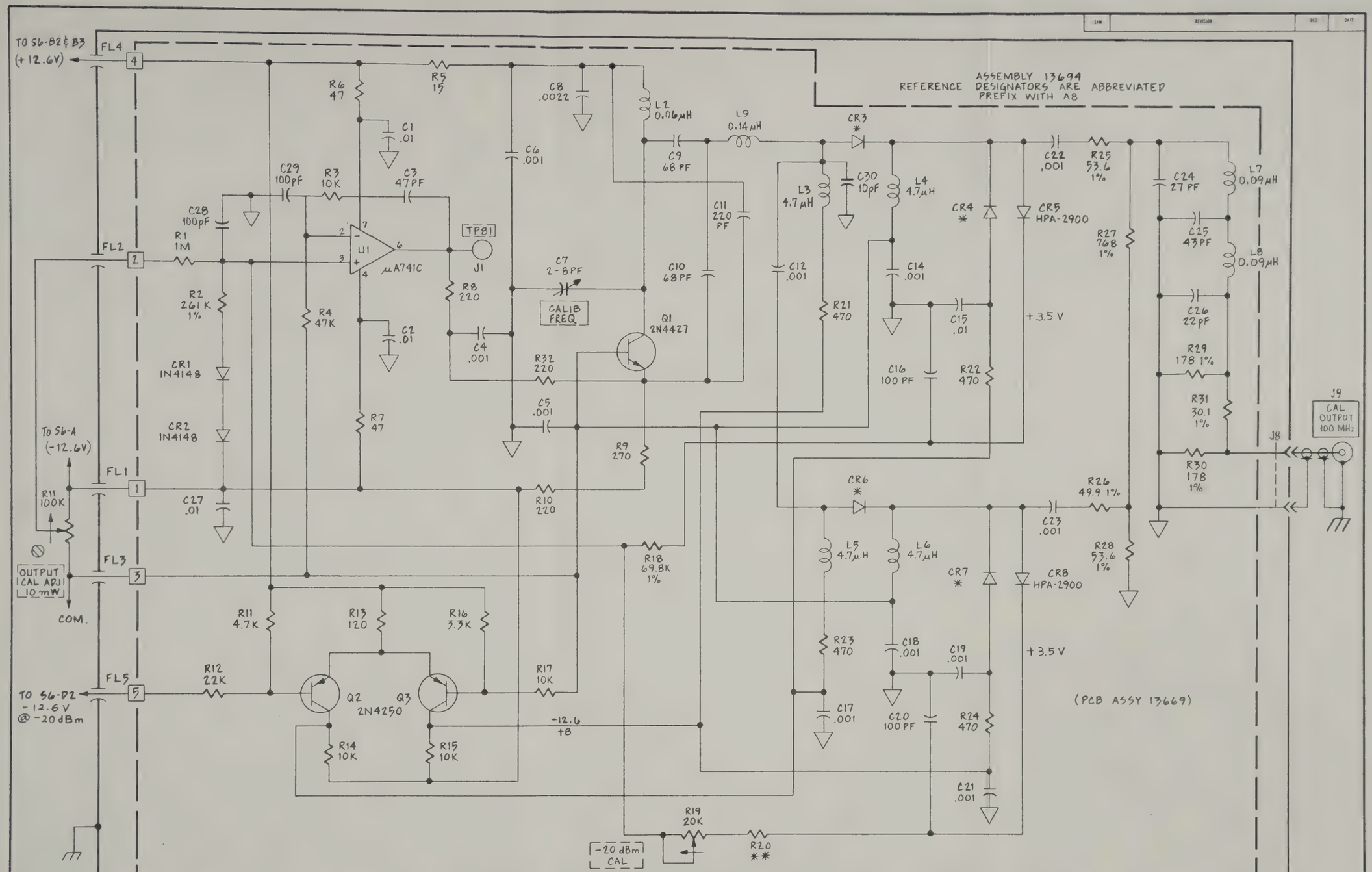


CALIBRATOR OSCILLATOR BOARD ASSEMBLY
FIGURE 7-10


SYM
REVISION
ECO
DATE
TO S6-B2 & B3
(+12.6V)
SEMBLY 13694
SIGNATORS ARE ABBREVIATED
REFIX WITH A8
C22
.001
R25
53.6
1%
C24
27 PF
L7
0.09μH
CR5
HPA-2900
R27
768
1%
C25
43PF
L8
0.09μH
C26
22pF
+3.5 V
R29
178 1%
R31
30.1
1%
J9
CAL
OUTPUT
100 MHz
J8
TO S6-A
(-12.6V)
R30
178
1%
R26
49.9 1%
R11
100K
C23
.001
R28
53.6
1%
OUTPUT
CAL ADJ
10 mW
CR8
HPA-2900
COM.
+3.5 V
TO S6-D2
-12.6 V
@ -20dBm
(PCB ASSY 13669)
NO
DESCRIPTION
NEXT ASSY
DATE
6-29-77
7-7-77
PM
PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA
CALIBRATOR ASSY
DRAWING NO
13670
REV
C
SHEET 1 OF 1



CALIBRATOR OSCILLATOR BOARD ASSEMBLY
FIGURE 7-10



NOTE:

1. UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS AND ARE ±5% 1/4 WATT, CAPACITOR VALUES ARE IN MICROFARADS.
2. DIODES WITH * ARE HPA 5082-3188.
3. ** DENOTES FACTORY SELECTED VALUE.

ITEM	REQD	PART NO.	DESCRIPTION

LIST OF MATERIAL

NEXT ASSY

FINISH OR TREATMENT

UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE
.XX ± .015
.XXX ± .005

SCALE

DRAWN	J.S.	6-29-77
ENG	RB	7-7-77
PROD		

PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA

CALIBRATOR ASSY

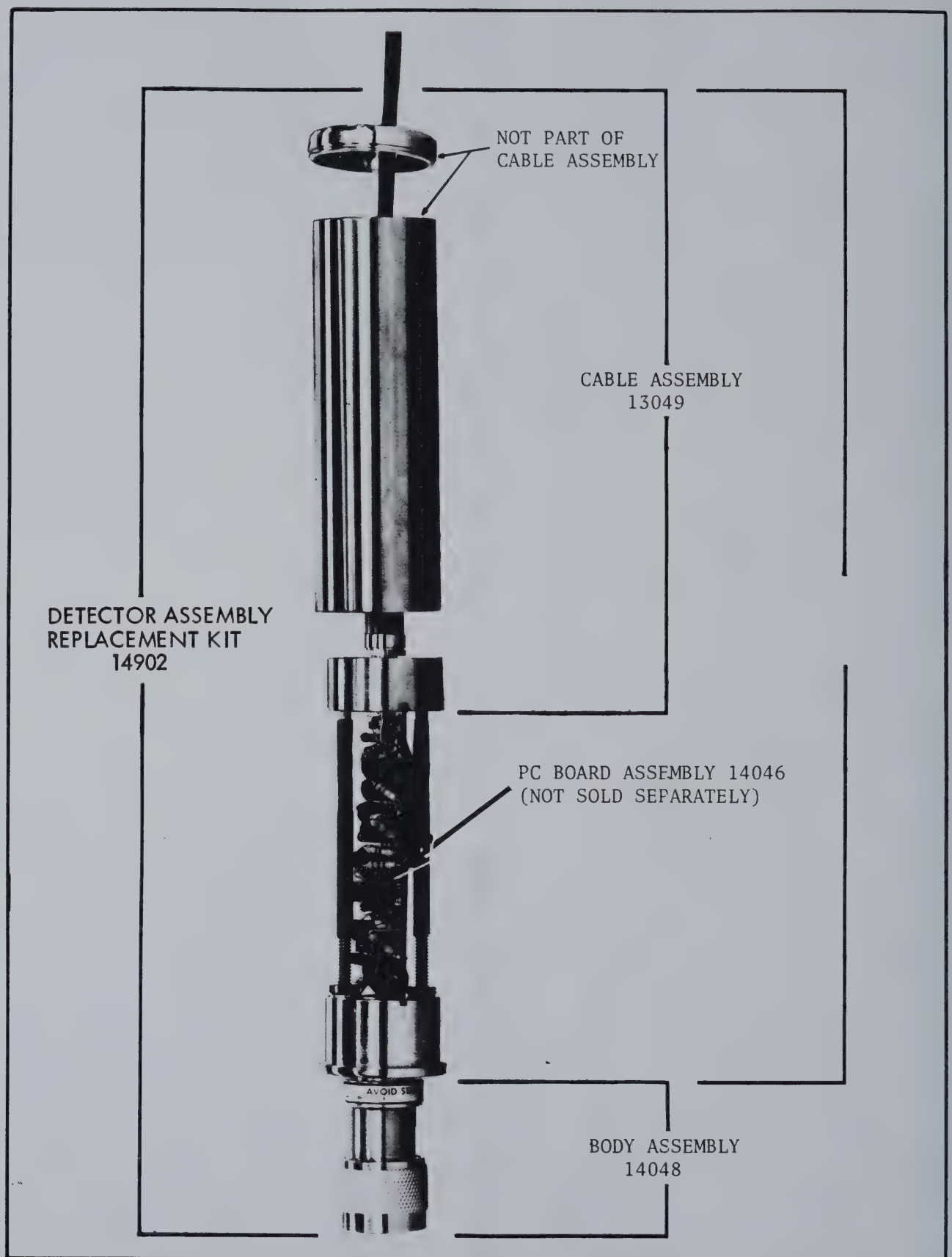
DRAWING NO 13670 REV C

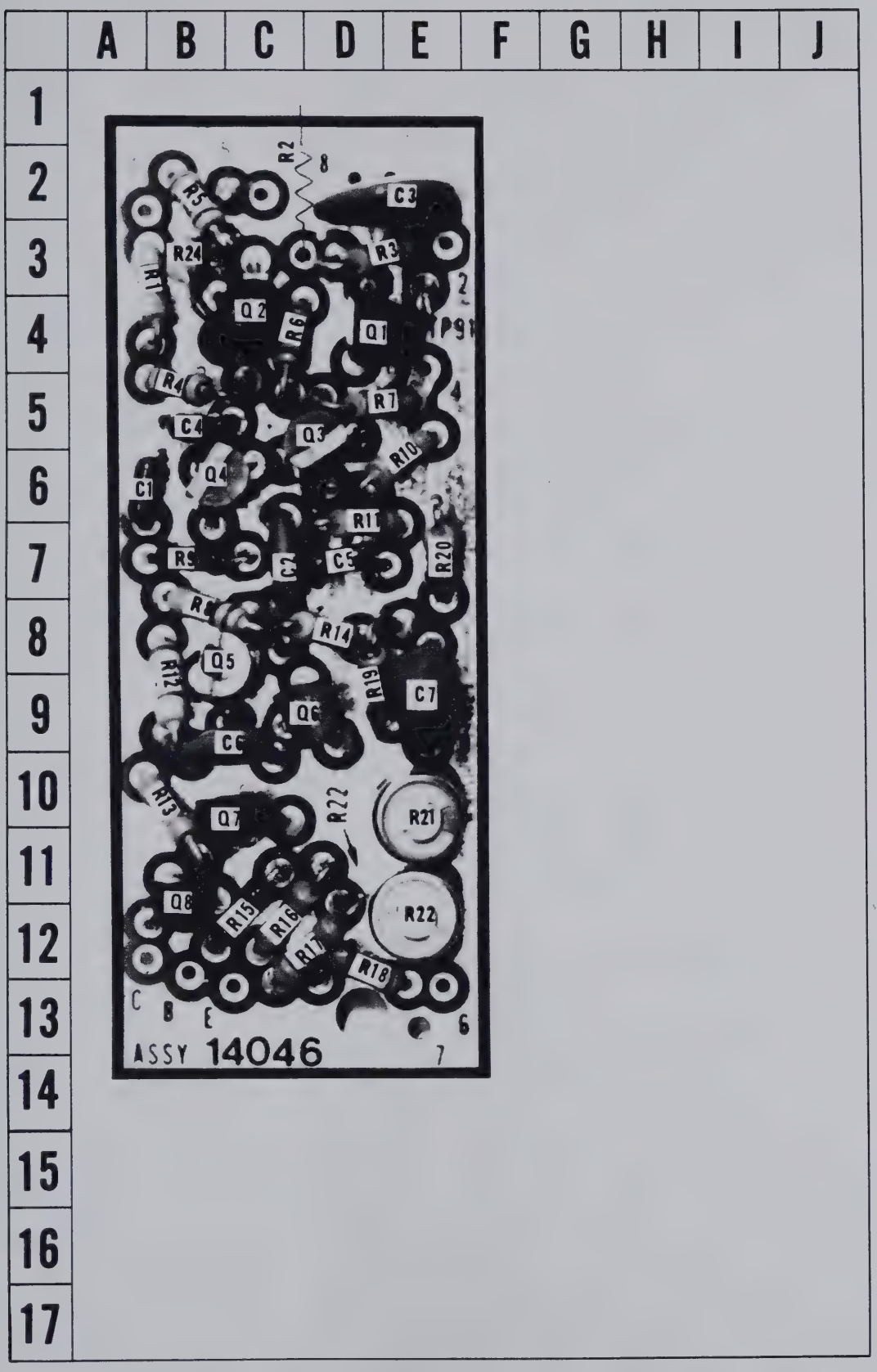
SHEET 1 OF 1

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	EMI PART NO.	TOT. QTY.
		DETECTOR ASSEMBLY REPLACEMENT KIT - 14902 (Refer to Fig. 7-11)		
		Cable Assy	13049	
A9C8	*	Cap, cer 0.1μ F 20% 50V	11501-2	4
		Body Assembly	14048	
A9CR1	*	Detector Element Replacement Kit	14904	
		Cap Assembly Replacement Kit	14034	
A9R2	*	Res, met flm, 4.99KΩ 1/4W (Part of Cap Assy 14034)	10015-65	1
A9L1	*	Shield Bead (Part of Cap Assy 14034)	10182	1
A9Q9	*	Transistor, 2N3646 (Part of Cap Assy 14034)	10018	1
		PULSE AMPLIFIER PC BOARD ASSEMBLY - 14046 (Refer to Fig. 7-12)		
A9C1	B-6	Cap, cer, 0.1 μF 20% 50V	11501-2	Ref
A9C2	C-8	Cap, cer, .01 μF 20% 100V	10000-11	1
A9C3	D-3	Cap, cer, .0047 μF 20% 500V	10000-6	1
A9C4	B-5	Cap, cer, 0.1 μF ±20% 50V	11501-2	Ref
A9C5	D-7	Cap, cer, 0.1 μF ±20% 50V	11501-2	Ref
A9C6	B-10	Cap, cer, 470 pF 20% 1000V	10000-3	1
A9C7	E-9	Cap, cer, 1.0 pF ±.25 pF 500V	10133-3	1
A9C8	*	See Detector Replacement Kit Assembly 14902		
A9L1	*	See Detector Replacement Kit Assembly 14902		
A9Q1	D-4	Transistor, 2N5245	**12163-2	1
A9Q2	B-4	Transistor, 2N5245	**12163-2	Ref
A9Q3	D-6	Transistor, 2N4121	10398	2
A9Q4	B-6	Transistor, 2N4121	10398	Ref
A9Q5	B-9	Transistor, 2N3563 B>45	10681	2
A9Q6	D-10	Transistor, 2N3563 B>45	10681	Ref
A9Q7	B-11	Transistor, 2N3563	10021	2
A9Q8	B-12	Transistor, 2N3563	10021	Ref
A9Q9	*	See Detector Replacement Kit 14902		
A9R1	B-4	Res, car flm, 10Ω 5% 1/4W	10013-1	2
A9R2	*	See Detector Replacement Kit 14902		
A9R3	D-3	Res, car flm, 22KΩ 5% 1/4W	10013-41	1
A9R4	B-5	Res, met flm, 825Ω 1% 1/8W	10015-132	2
A9R5	B-3	Res, met flm, 825Ω 1% 1/8W	10015-132	Ref
A9R6	C-4	Res, met flm, 2.26KΩ 1% 1/8W	10015-78	1
A9R7	D-5	Res, car flm, 10Ω 5% 1/4W	10013-1	Ref
A9R8	B-8	Res, car flm, 5% 1/4W Factory Selected Value		1
A9R9	B-7	Res, car flm, 1KΩ 5% 1/4W	10013-25	1
A9R10	E-6	Res, car flm, 6.8KΩ 5% 1/4W	10013-35	2
A9R11	D-7	Res, car flm, 6.8KΩ 5% 1/4W	10013-35	Ref
A9R12	B-9	Res, car flm, 5% 1/4W Factory Selected Value		1
A9R13	B-11	Res, car flm, 1.5KΩ 5% 1/4W	10013-27	3
A9R14	D-9	Res, car flm, 470Ω	10013-21	1
A9R15	C-12	Res, car flm, 2.2KΩ 5% 1/4W	10013-29	1
A9R16	D-12	Res, car flm, 1.5KΩ 5% 1/4W	10013-27	Ref
A9R17	D-13	Res, car flm, 1.5KΩ 5% 1/4W	10013-27	Ref
A9R18	D-13	Res, met flm, 49.9Ω 1% 1/8W	10015-3	1
A9R19	E-9	Res, met flm, 23.7K 1%	10015-28	1
A9R20	E-8	Res, car flm, 100Ω 5% 1/4W	10013-13	2
A9R21	E-11	Res, var cerm, 1KΩ 20% 1/2W	11499-1	2
A9R22	E-12	Res, var cerm, 1KΩ 20% 1/2W	11499-1	Ref
A9R23		Not Used		
A9R24	*	Res, car flm, 100Ω 5% 1/4W	10013-13	Ref

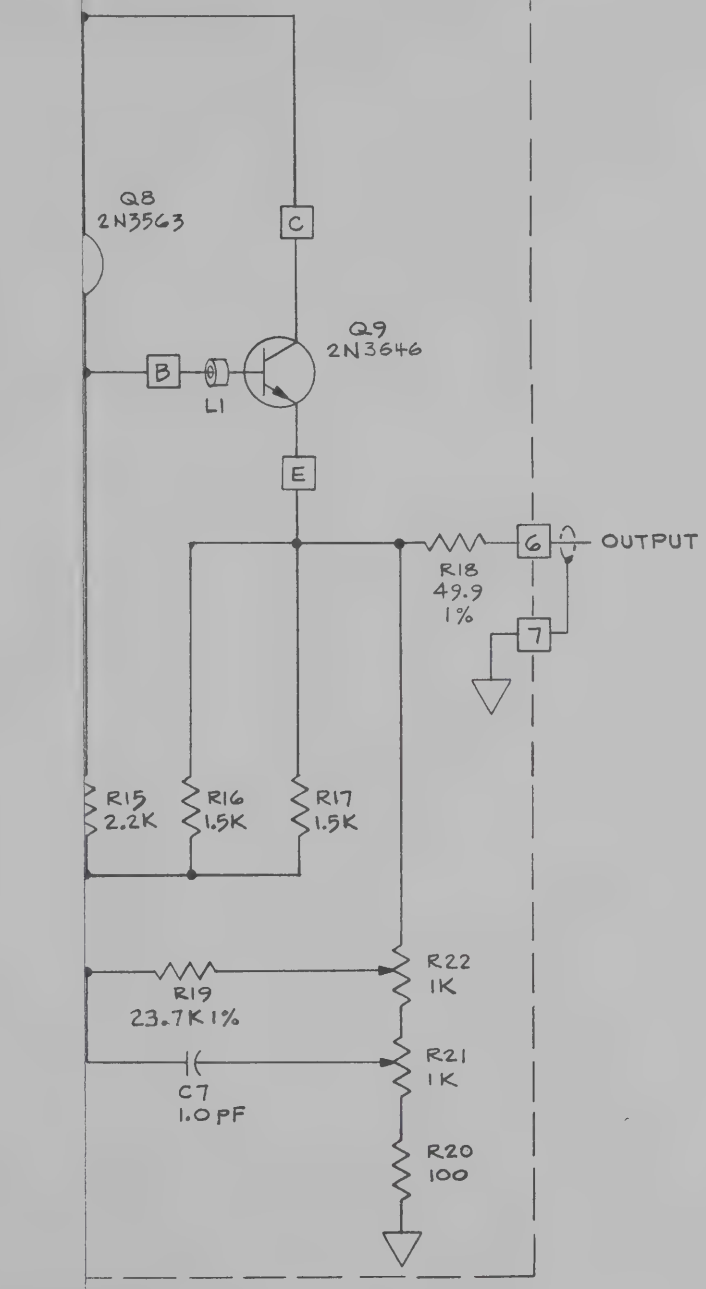
*Not Illustrated **Matched Pair


NOT PART OF
CABLE ASSEMBLY
CABLE ASSEMBLY
13049
DETECTOR ASSEMBLY
REPLACEMENT KIT
14902
PC BOARD ASSEMBLY 14046
(NOT SOLD SEPARATELY)
BODY ASSEMBLY
14048



PULSE AMPLIFIER BOARD ASSEMBLY
FIGURE 7-12

SYM	REVISION	ECO	DATE
A	CHANGED A9R19 TO 35.7K	602	7-5-79
B	R19 WAS 35.7K ; R2 WAS 10K	643	1-24-80
C	R19 WAS 17.8K	1533	8-8-84



NOTE

1.

2.

3.

4

DESCRIPTION	DATE
S	2-14-79

NEXT ASSY

PM PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA

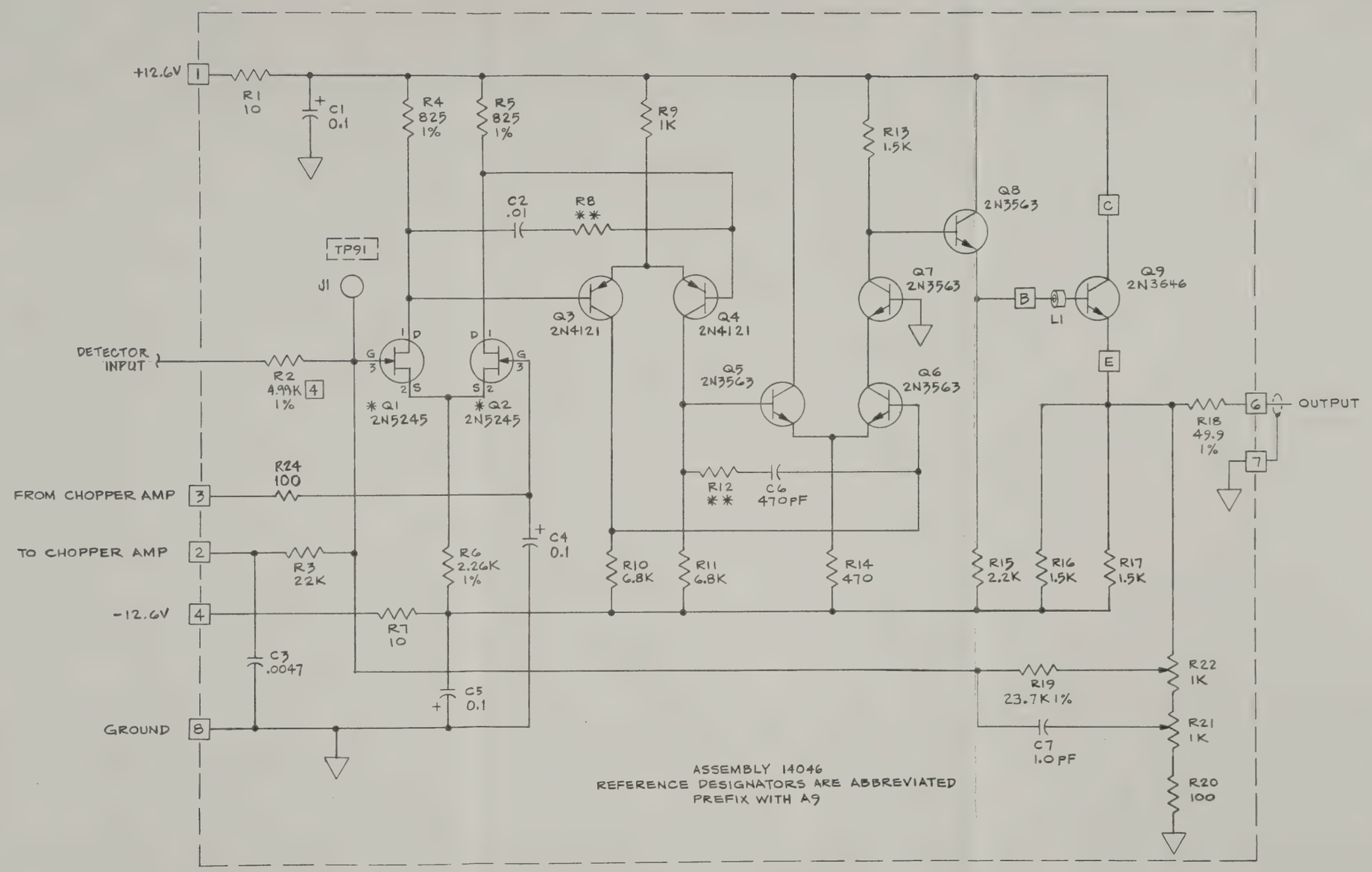
DETECTOR AMPLIFIER

DRAWING NO. 14077 REV C

SHEET 1 OF 1

STN	REVISION	ECN	DATE
A	CHANGED A9R19 TO 35.7K	602	7-5-79
B	R19 WAS 35.7K ; R2 WAS 10K	643	1-24-80
C	R19 WAS 17.8K	1533	8-8-84

ASSEMBLY 14034
REFERENCE DESIGNATORS ARE ABBREVIATED
PREFIX WITH A9



ASSEMBLY 14046
REFERENCE DESIGNATORS ARE ABBREVIATED
PREFIX WITH A9

NOTE:

1. UNLESS SPECIFIED OTHERWISE, RESISTOR VALUES ARE IN OHMS AND ARE ±5% 1/4 WATT. CAPACITOR VALUES ARE IN MICROFARADS.
2. * DENOTES MATCHED PAIR.
3. ** DENOTES FACTORY SELECTED VALUES.
4. [4] R2 IS PART OF POWER DETECTOR AMPL ASSY 13777.

ITEM	REQD	PART NO.	DESCRIPTION

LIST OF MATERIAL

NEXT ASSY

FINISH OR TREATMENT

UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE
.X ± .015
.XXX ± .005

SCALE

DRAWN HS 2-14-79
ENG
PROD

PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO, CALIFORNIA

DETECTOR AMPLIFIER

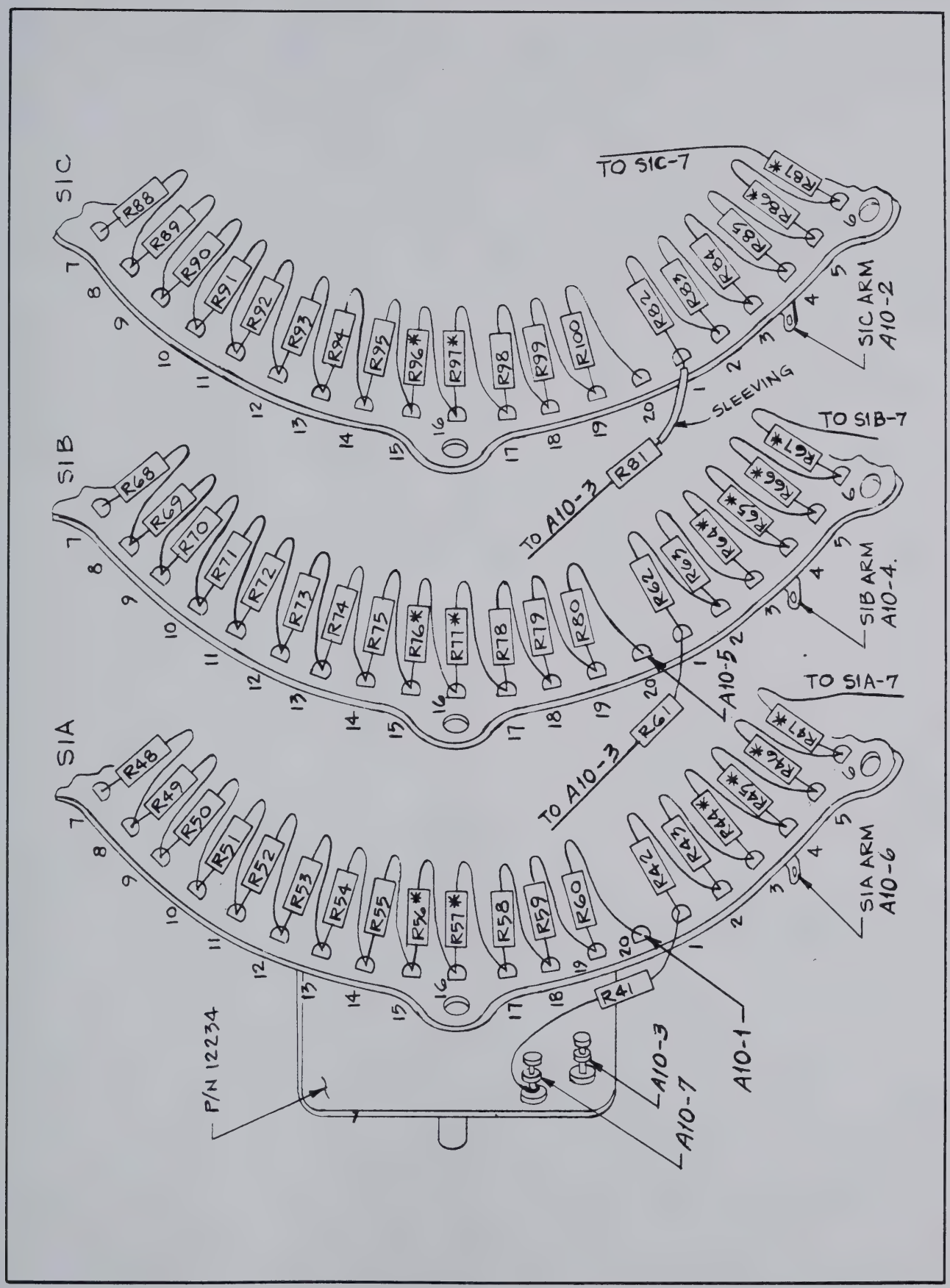
DRAWING NO. 14077 REV C

SHEET 1 OF 1

REPLACEABLE PARTS LIST				
REF. DESIG.	LOCA-TION	DESCRIPTION	HP PART NO.	TOT. QTY.
		CAL FACTOR SWITCH ASSEMBLY - 12088 (Refer to Fig. 7-13)		
A10R41		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	20
A10R42		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R43		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R44		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R45		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R46		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R47		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R48		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R49		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R50		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R51		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R52		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R53		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R54		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R55		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R56		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R57		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R58		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R59		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R60		Res, met flm, 1.00 KΩ 1% 1/8 W	10015-19	Ref
A10R61		Res, met flm, 226 Ω 1% 1/8 W	10015-147	2
A10R62		Res, met flm, 226 Ω 1% 1/8 W	10015-147	Ref
A10R63		Res, met flm, 221 Ω 1% 1/8 W	10015-197	2
A10R64		Res, met flm, 221 Ω 1% 1/8 W	10015-197	Ref
A10R65		Res, met flm, 215 Ω 1% 1/8 W	10015-169	3
A10R66		Res, met flm, 215 Ω 1% 1/8 W	10015-169	Ref
A10R67		Res, met flm, 215 Ω 1% 1/8 W	10015-169	Ref
A10R68		Res, met flm, 210 Ω 1% 1/8 W	10015-52	1
A10R69		Res, met flm, 205 Ω 1% 1/8 W	10015-196	3
A10R70		Res, met flm, 205 Ω 1% 1/8 W	10015-196	Ref
A10R71		Res, met flm, 205 Ω 1% 1/8 W	10015-196	Ref
A10R72		Res, met flm, 200 Ω 1% 1/8 W	10015-195	2
A10R73		Res, met flm, 200 Ω 1% 1/8 W	10015-195	Ref
A10R74		Res, met flm, 196 Ω 1% 1/8 W	10015-69	1
A10R75		Res, met flm, 191 Ω 1% 1/8 W	10015-194	3
A10R76		Res, met flm, 191 Ω 1% 1/8 W	10015-194	Ref
A10R77		Res, met flm, 191 Ω 1% 1/8 W	10015-194	Ref
A10R78		Res, met flm, 187 Ω 1% 1/8 W	10015-193	2
A10R79		Res, met flm, 187 Ω 1% 1/8 W	10015-193	Ref
A10R80		Res, met flm, 182 Ω 1% 1/8 W	10015-192	1
A10R81		Res, met flm, 232 Ω 1% 1/8 W	10015-198	2
A10R82		Res, met flm, 232 Ω 1% 1/8 W	10015-198	Ref
A10R83		Res, met flm, 237 Ω 1% 1/8 W	10015-199	2
A10R84		Res, met flm, 237 Ω 1% 1/8 W	10015-199	Ref
A10R85		Res, met flm, 243 Ω 1% 1/8 W	10015-200	2
A10R86		Res, met flm, 243 Ω 1% 1/8 W	10015-200	Ref
A10R87		Res, met flm, 249 Ω 1% 1/8 W	10015-46	2
A10R88		Res, met flm, 249 Ω 1% 1/8 W	10015-46	Ref
A10R89		Res, met flm, 255 Ω 1% 1/8 W	10015-44	3
A10R90		Res, met flm, 255 Ω 1% 1/8 W	10015-44	Ref
A10R91		Res, met flm, 255 Ω 1% 1/8 W	10015-44	Ref
A10R92		Res, met flm, 261 Ω 1% 1/8 W	10015-83	1
A10R93		Res, met flm, 267 Ω 1% 1/8 W	10015-201	2

REPLACEABLE PARTS LIST

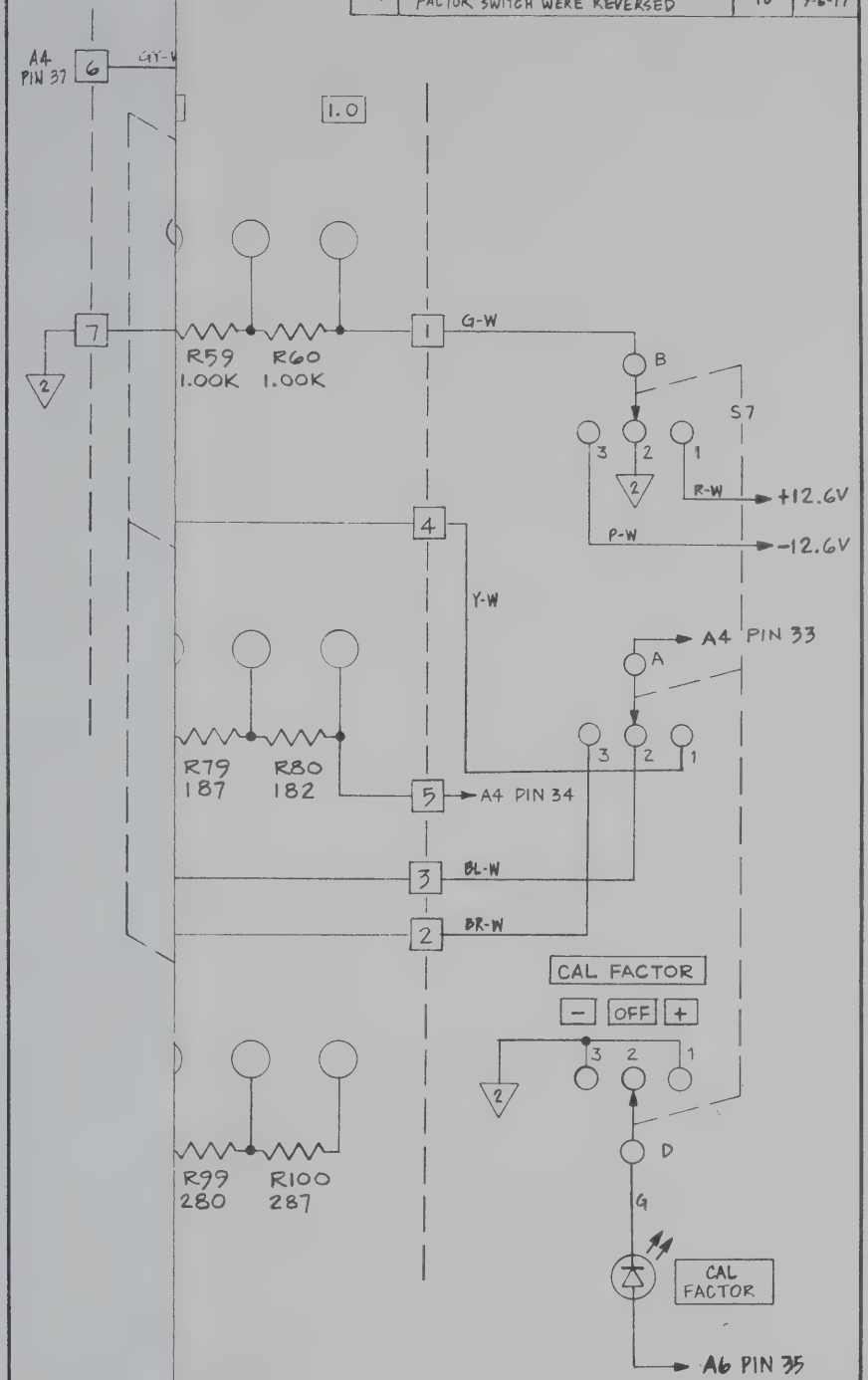
REF. DESIG.	LOCATION	DESCRIPTION	PM PART NO.	TOT. QTY.
A10R94		Res, met flm, 267 Ω 1% 1/8 W	10015-201	Ref
A10R95		Res, met flm, 274 Ω 1% 1/8 W	10015-202	3
A10R96		Res, met flm, 274 Ω 1% 1/8 W	10015-202	Ref
A10R97		Res, met flm, 274 Ω 1% 1/8 W	10015-202	Ref
A10R98		Res, met flm, 280 Ω 1% 1/8 W	10015-203	2
A10R99		Res, met flm, 280 Ω 1% 1/8 W	10015-203	Ref
A10R100		Res, met flm, 287 Ω 1% 1/8 W	10015-204	1
A10S1		Switch, Rotary 3P20T	12021	1



CALIBRATOR FACTOR SWITCH

FIGURE 7-13

SYM	REVISION	ECO	DATE
A	+12.6V & -12.6V CONNECTIONS TO CAL FACTOR SWITCH WERE REVERSED	YO	9-6-77



DESCRIPTION	DATE	NEXT ASSY
O	12-1-71	
B	6-21-72	

PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO CALIFORNIA

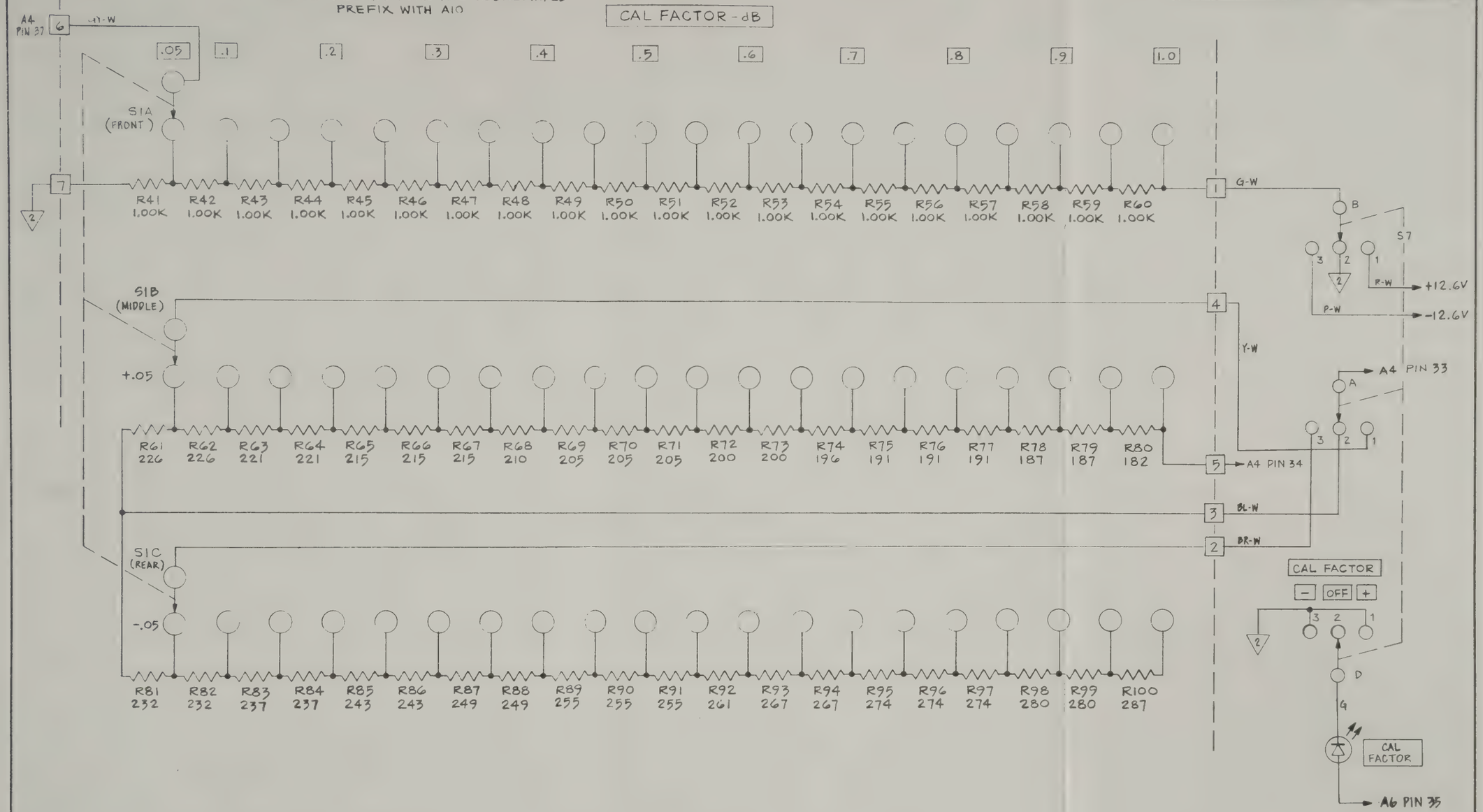
CAL FACTOR SWITCHING

DRAWING NO. 12089 REV B

SHEET 1 OF 1

SYM	REVISION	ECO	DATE
A	+12.6V & -12.6V CONNECTIONS TO CAL FACTOR SWITCH WERE REVERSED	YO	9-6-77

ASSEMBLY 12088
REFERENCE DESIGNATORS ARE ABBREVIATED
PREFIX WITH A10



NOTE
UNLESS OTHERWISE SPECIFIED, RESISTOR VALUES ARE IN OHMS AND ARE ±1% 1/4 WATT.

ITEM	REQD	PART NO	DESCRIPTION

LIST OF MATERIAL

NEXT ASSY

FINISH OR TREATMENT

UNLESS OTHERWISE INDICATED DIMENSIONS ARE IN INCHES
TOLERANCE
XX - .015
XXX - .005
SCALE

		DATE
DRAWN	YO	12-1-71
ENG	RB	6-21-72
PROD		

PM PACIFIC MEASUREMENTS INCORPORATED
PALO ALTO CALIFORNIA

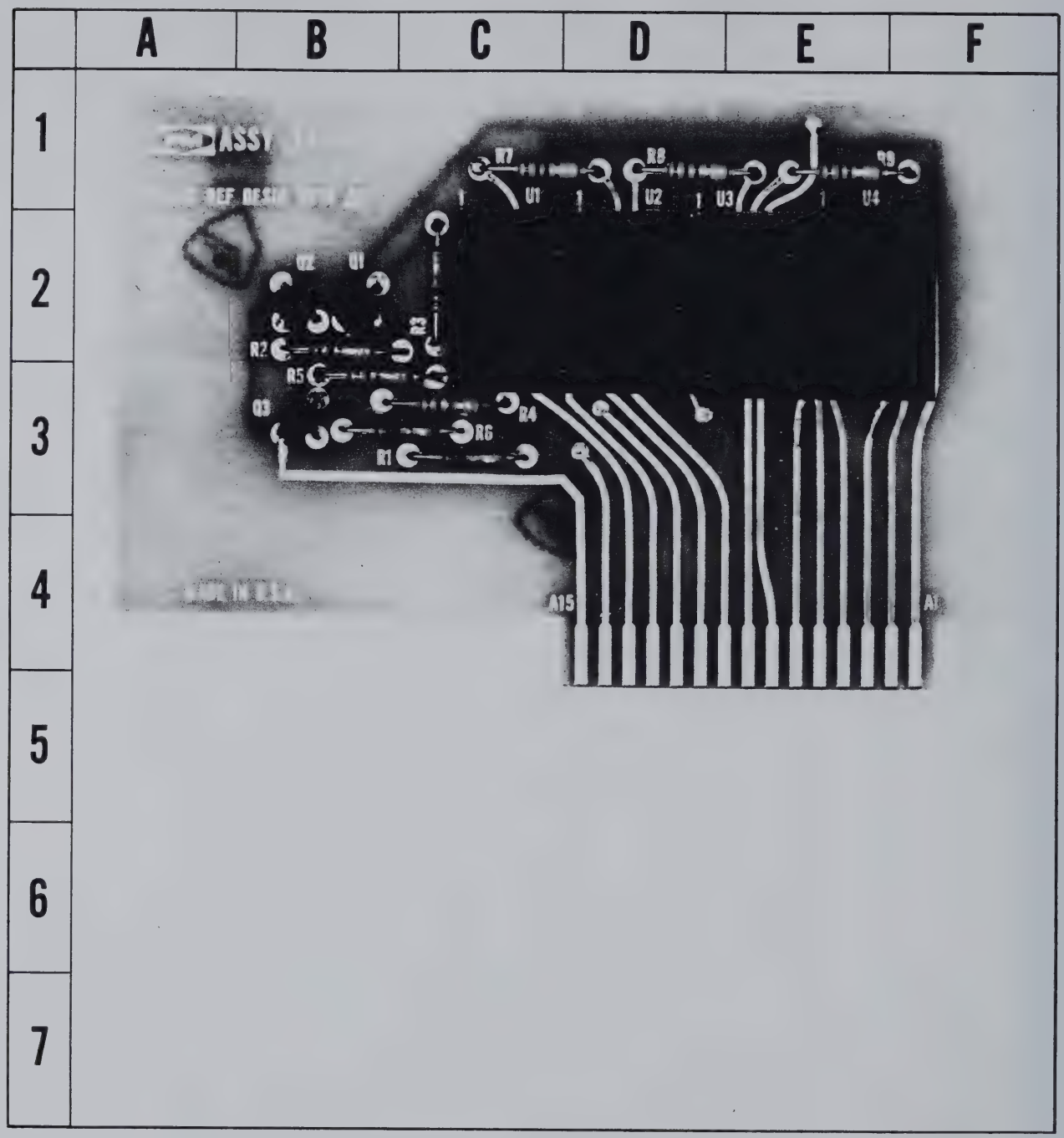
CAL FACTOR SWITCHING

DRAWING NO 12089 REV B

SHEET 1 OF 1

REPLACEABLE PARTS LIST

REF. DESIG.	LOCATION	DESCRIPTION	PART NO.	TOT. QTY.
		DISPLAY READOUT PC BOARD ASSY-13345 (Refer to Fig. 7-14)		
A11Q1		Transistor, 2N3569	10017	3
A11Q2		Transistor, 2N3569	10017	Ref
A11Q3		Transistor, 2N3569	10017	Ref
A11R1		Res, car. flm, 10 KΩ 5% 1/4W	10013-37	3
A11R2		Res, car. flm, 10 KΩ 5% 1/4W	10013-37	Ref
A11R3		Res, car. flm, 180 Ω 5% 1/4W	10013-16	1
A11R4		Res, car. flm, 390 Ω 5% 1/4W	10013-20	4
A11R5		Res, car. flm, 220 Ω 5% 1/4W	10013-17	1
A11R6		Res, car. flm, 10 KΩ 5% 1/4W	10013-37	Ref
A11R7		Res, car. flm, 390 Ω 5% 1/4W	10013-20	Ref
A11R8		Res, car. flm, 390 Ω 5% 1/4W	10013-20	Ref
A11R9		Res, car. flm, 390 Ω 5% 1/4W	10013-20	Ref
A11U1		LED, Plus-minus-one, Red	13418	1
A11U2		LED, Numeric, Red	13417	3
A11U3		LED, Numeric, Red	13417	Ref
A11U4		LED, Numeric, Red	13417	Ref
		Socket, IC, 14 pin	16556-1	4



DISPLAY READOUT BOARD ASSEMBLY

FIGURE 7-14

PART NO. CROSS REFERENCE		
PM PART NO.	MFGR. CODE	MFGR. PART NO.
10000-1	56289	5GA-T10
10000-2	56289	5GA-T22
10000-3	56289	5GA-T47
10000-4	56289	5GA-D10
10000-5	56289	5GA-D22
10000-6	56289	5GAB-D47
10000-7	56289	5GAS-S10
10000-10	91418	Type TA 0.1 µF
10000-11	72982	805-000-X5V0-103Z
10000-12	56289	5GA-T15
10001-2	56289	10TCC-V47
10001-3	56289	10TCC-Q10
10001-4	56289	10TCC-Q22
10001-5	56289	10TCC-Q33
10001-6	56289	10TCC-Q47
10001-9	56289	10TCC-V68
10001-14	56289	10TCC-Q68
10001-15	56289	10TCC-T15
10001-19	56289	10TCC-Q27
10001-22	56289	10TCC-Q56
10003-3	12674	EMW-2468
10003-4	56289	TVA-1608
10003-6	25088	B41010-220/40/8212
10003-7	25088	B41010-1000/40/8212
10007-1	01002	75F1R2A 102
10007-5	01002	75F1R2A 223
10007-6	01002	75F1R2A 473
10007-7	01002	75F1R2A 104
10008-8	01002	75F1R2A 224

PART NO. CROSS REFERENCE		
PM PART NO.	MFGR. CODE	MFGR. PART NO.
10011-1	27556	ZA2060K 10%
10013-1	73445	B803104NB 100
10013-5	73445	B803104NB 220
10013-9	73445	B803104N 470
10013-11	73445	B803104N 680
10013-13	73445	B803104N 101
10013-14	73455	B803104N 121
10013-17	73445	B803104N 221
10013-19	73445	B803104N 331
10013-21	73445	B803104N 471
10013-23	73445	B803104N 681
10013-25	73445	B803104N 102
10013-27	73445	B803104N 152
10013-29	73445	B803104N 222
10013-31	73445	B803104N 332
10013-33	73445	B803104N 472
10013-35	73445	B803104N 682
10013-37	73445	B803104N 103
10013-39	73445	B803104N 153
10013-41	73445	B803104N 223
10013-43	73445	B803104N 333
10013-45	73445	B803104N 473
10013-47	73445	B803104N 683
10013-49	73445	B803104N 104
10013=51	73445	B803104N 154
10013-53	73455	B803104N 224
10013-57	73445	B803104N 474
10013-59	73445	B803104N 684
10013-61	73445	B803104N 105
10013-63	01121	CB1555
10013-65	01121	CB2255
10013-68	01121	CB3955
10013-69	01121	CB4755
10013-73	01121	CB1065
10013-74	01121	CB2055
10015-1	01295	RN55D, 1.54K 1%
10015-3	01295	RN55D, 49.9 Ω 1%
10015-5	01295	RN55D, 215 KΩ 1%
10015-6	01295	RN55D, 464K Ω 1%
10015-7	01295	RN55D, 10.0K Ω 1%
10015-8	01295	RN55D, 38.3K Ω 1%
10015-9	01295	RN55D, 17.8K Ω 1%
10015-10	01295	RN55D, 14.7K Ω 1%
10015-13	01295	RN55D, 100K Ω 1%
10015-14	01295	RN55D, 31.6K Ω 1%
10015-15	01295	RN55D, 21.5K Ω 1%
10015-19	01295	RN55D, 1.00K Ω 1%
10015-25	01295	RN55D, 61.9K Ω 1%

PART NO. CROSS REFERENCE		
PM PART NO.	MFGR. CODE	MFGR. PART NO.
10015-26	01295	RN55D, 154K Ω 1%
10015-30	01295	RN55D, 7.68K Ω 1%
10015-32	01295	RN55D, 3.83K Ω 1%
10015-41	01295	RN55D, 48.7K Ω 1%
10015-43	01295	RN55D, 121K Ω 1%
10015-44	01295	RN55D, 255 Ω 1%
10015-45	01295	RN55D, 499K Ω 1%
10015-46	01295	RN 5D, 249 Ω 1%
10015-48	01295	RN55D, 27.4K Ω 1%
10015-52	01295	RN55D, 210 Ω 1%
10015-54	01295	RN55D, 110K Ω 1%
10015-60	01295	RN55D, 19.6K Ω 1%
10015-61	01295	RN55D, 39.2K Ω 1%
10015-62	01295	RN55D, 200K Ω 1%
10015-63	01295	RN55D, 402K Ω 1%
10015-65	01295	RN55D, 4.99K Ω 1%
10015-66	01295	RN55D, 9.53K Ω 1%
10015-67	01295	RN55D, 143K Ω 1%
10015-68	01295	RN55D, 100 Ω 1%
10015-69	01295	RN55D, 196 Ω 1%
10015-74	01295	RN55D, 2.00K Ω 1%
10015-75	01295	RN55D, 1.33K Ω 1%
10015-77	01295	RN55D, 1.24K Ω 1%
10015-78	01295	RN55D, 2.26K Ω 1%
10015-80	01295	RN55D, 4.02K Ω 1%
10015-81	01295	RN55D, 11.3K Ω 1%
10015-83	01295	RN55D, 261 Ω 1%
10015-85	01295	RN55D, 287K Ω 1%
10015-87	01295	RN55D, 15.0K Ω 1%
10015-88	01295	RN55D, 27.4Ω 1%
10015-91	01295	RN55D, 90.9 KΩ 1%
10015-104	01295	RN55D, 5.62K Ω 1%
10015-105	01295	RN55D, 6.19K Ω 1%
10015-106	01295	RN55D, 6.81K Ω 1%
10015-108	01295	RN55D, 191K Ω 1%
10015-110	01295	RN55D, 3.01K Ω 1%
10015-113	01295	RN55D, 75.0 Ω 1%
10015-120	01295	RN55D, 69.8K Ω 1%
10015-128	01295	RN55D, 43.2 Ω 1%
10015-129	01295	RN55D, 53.6 Ω 1%
10015-132	01295	RN55D, 825 Ω 1%
10015-133	01295	RN55D, 49.9K Ω 1%
10015-137	01295	RN55D, 39.2 Ω 1%
10015-139	01295	RN55D, 133 Ω 1%
10015-141	01295	RN55D, 316K Ω 1%
10015-145	01295	RN55D, 127 Ω 1%
10015-146	01295	RN55D, 162 Ω 1%

PART NO. CROSS REFERENCE		
PM PART NO.	MFGR. CODE	MFGR. PART NO.
10015-147	01295	RN55D, 226Ω 1%
10015-148	01295	RN55D, 11.5 Ω 1%
10015-149	01295	RN55D, 16.9 Ω 1%
10015-150	01295	RN55D, 46.4 Ω 1%
10015-151	01295	RN55D, 59.0 Ω 1%
10015-154	01295	RN55D, 806 Ω 1%
10015-155	01295	RN55D, 169 Ω 1%
10015-169	01295	RN55D, 215 Ω 1%
10015-176	01295	RN55D, 3.48K Ω 1%
10015-184	01295	RN55D, 243K Ω 1%
10015-192	01295	RN55D, 182 Ω 1%
10015-193	01295	RN55D, 187 Ω 1%
10015-194	01295	RN55D, 191 Ω 1%
10015-195	01295	RN55D, 200Ω 1%
10015-196	01295	RN55D, 205 Ω 1%
10015-197	01295	RN55D, 221 Ω 1%
10015-198	01295	RN55D, 232 Ω 1%
10015-199	01295	RN55D, 237 Ω 1%
10015-200	01295	RN55D, 243 Ω 1%
10015-201	01295	RN55D, 267 Ω 1%
10015-202	01295	RN55D, 274 Ω 1%
10015-203	01295	RN55D, 280 Ω 1%
10015-204	01295	RN55D, 287 Ω 1%
10017	07263	2N3569
10018	07263	2N3646
10019	07263	2N3565
10020	02735	40250
10021	07263	2N3563
10023	07263	2N3644
10043	09214	1N4148
10044-1	11711	1N4383
10044-2	11711	1N4385
10045	07910	1N823
10046-1	71450	X201R501B
10046-2	71450	X201R203B
10046-3	71450	X201R503B
10046-4	71450	X201R502B
10046-5	71450	X201R202B
10046-6	71450	X201R201B
10046-7	71450	X201R102B
10046-8	71450	X201R103B
10046-9	71450	X201R101B
10046-10	71450	X201R104B
10046-11	71450	X201R254B
10046-13	71450	X201R105B
10048	02660	31-221-1050

PART NO. CROSS REFERENCE		
PM PART NO.	MFGR. CODE	MFGR. PART NO.
10050-1	02660	225-21513-101
10054-1	74970	105752
10054-2	74970	105753
10054-3	74970	105760
10057	09353	7201 P3
10058	82389	#913
10064-2	75915	312.500
10095-3	71450	Series 45, 1.5 KΩ
10133-3	00656	Type CN, NPO 1.0pF
10140-1	74970	105852
10140-2	74970	105857
10140-3	74970	105853
10142-4	01121	CB2265
10182	02114	56-59065/3B
10206	07263	2N3053
10209	90634	51RD21
10325	28821	10325
10339	07263	2N4360
10398	07263	PN4917
10416	28821	10416
10450	76854	399163-184
10501-3	18235	1.84KΩ 1%, 538
10585-2	56289	CA28B102F331J
10585-3	56289	CA28B102G471J
10585-5	56289	CA28B102F331J
10630-1	72982	538-011A-2-8
10631-1	72982	538-011-89A
10631-2	99800	1025-50
10631-3	99800	1025-12
10631-15	99800	1025-36
10677-2	84171	DM15F221J-500V-4CR
10677-3	84171	DM19F252J-500V-4CR
10677-7	84171	DM15E680J-500V-4CR
10677-16	84171	DM15F430J-500V-4CR
10725-4	22045	J110, 17.555K Ω0.05%
10725-5	22045	J110, 142.20K Ω0.05%
10725-7	22045	J110, 158.00K Ω0.05%
10725-8	22045	J110, 15.80K Ω0.05%
10769	04713	MC1709CG

PART NO. CROSS REFERENCE		
PM PART NO.	MFGR. CODE	MFGR. PART NO.
10787-1	56289	196D475X0035JA1
10787-2	12954	D12GSB20M
10787-3	12954	D27GSB15M
10787-4	12954	D68GSC15M
10787-5	56289	196D105X0035HA1
10787-6	12954	D2R7GSA15M
10787-8	56289	196D474X0035HA1
10787-10	56289	196D107X0020MA3
10803-1	94144	DS70-1BD-2G
10804-1	94144	DS70B-3-2G
10811-1	28821	10811-1
10811-2	28821	10811-2
10811-3	28821	10811-3
10811-4	28821	10811-4
10818-1	72982	2443-000 1000pF 20%
10896	02735	3N138
10978-1	00779	583527-1
10978-2	00779	583529-1
11104	28821	11104
11116	02735	CA3030
11118	02735	CA3039
11119	07263	2N4250
11230	07263	U5B7710393
11270-3	01295	SN7420N
11270-24	01295	SN74121N
11345	28480	HPA 2900
11432	27014	FM3955
11433	02735	2N3440
11434	04713	1N5276B
11485-13	14298	REA C-2, 63.00K Ω 1%
11499-1	71450	340PC102B
11501-2	72982	8131-050-651-104M
11504	28821	11504
11507	01295	TIS 97
11518-1	14298	Style CE 1/8
11536	28821	11536
11539	07263	U5B7741393

PART NO. CROSS REFERENCE		
PM PART NO.	MFGR. CODE	MFGR. PART NO.
11683	28821	11683
11688-1	71450	B-185-HT-104-B
11689	24931	28JR106-6
11691	07263	LM311H
11692	07263	2N5833
11695-16	22045	J110 4.958K .01%
11695-17	22045	J110 9.945K .01%
11695-18	22045	J110 19.935K .01%
11711-1	71450	M165W
11711-2	73138	Series 66 W, 100 KΩ
11730	91929	22M723-T2
11856	71400	Type HMB
11962	09161	P.E. 5784
12021	28821	12021
12024	72982	1202-052
12025-1	72982	Type 669-013, 24 pF
12025-2	72982	Type 660-013, 56 pF
12026	28821	12026
12027	28821	12027
12111	28821	12111
12132	28821	12132
12134	01969	PE #5761
12159	02735	2N4427
12163-2	28821	12163-2
12166	28821	12166
12205	28821	12205
12248	00779	85865-3
12356	82389	P2392
12389	76541	MV5025
12395	27014	LM3024
12449-21	14298	EE 1/8 C2, 10.00 KΩ 0.1%
12449-32	14298	EE 1/8 C2, 1.250 KΩ 0.1%
12449-33	14298	EE 1/8 C2, 100.0KΩ 0.1%
12449-37	14298	EE 1/8 C2, 20.000 KΩ 0.1%
12449-46	14298	EE 1/8 C2, 416.7 Ω 0.1%
12449-51	14298	EE 1/8 C2, 2.000 KΩ 0.1%
12449-52	14298	EE 1/8 C2, 39.96 KΩ 0.1%
12449-53	14298	EE 1/8 C2, 50.00 KΩ 0.1%
12449-54	14298	EE 1/8 C2, 1.333 KΩ 0.1%
12449-55	14298	EE 1/8 C2, 4.000 KΩ 0.1%

PART NO. CROSS REFERENCE		
PM PART NO.	MFGR. CODE	MFGR. PART NO.
12449-56	14298	EE 1/8 C2, 3.966 KΩ 0.1%
12497-1	28821	12497-1
12591	17856	E112
12647	28821	12647
13267-1	31223	MPO100-15-DS-4
13300-2	71450	375T103B
13300-3	71450	375T203B
13417	28480	5082-7650
13418	28480	5082-7652
13447	28821	13447
13457	76541	5152
13470-1	01295	SN74LS00N
13470-4	01295	SN74LS04N
13470-6	01295	SN74LS10N
13470-9	01295	SN74LS27N
13470-12	01295	SN74LS42N
13470-13	01295	SN74LS74N
13470-15	01295	SN74LS90N
13470-16	01295	SN74LS107N
13470-19	01295	SN74LS247N
13471	27014	LM324
13473-1	01295	SN74S260N
13479-1	27014	LM340
13492	05245	6J1
13534	04713	2N2221
13550	76541	5353
13687	28480	HPA5082-3188
13689	28821	13689
13793	28821	13793
14219	28821	14219

FEDERAL SUPPLY CODES FOR MANUFACTURERS

The following five-digit code numbers are listed in numerical sequence along with the manufacturer's name and location to which the code has been assigned. The Federal Supply Code has been taken from Cataloging Handbook H 4-1, Name to Code.

00303	Shelly Associates Inc. El Segundo, California
00656	Aerovox Corp. New Bedford, Massachusetts
00779	AMP Inc. Harrisburg, Pennsylvania
01002	General Electric Co. Capacitor Dep't. Hudson Falls, New York
01121	Allan-Bradley Co. Milwaukee, Wisconsin
01295	Texas Instruments Inc. Semiconductor Components Div. Dallas, Texas
01961	Pulse Engineering Inc. Santa Clara, California
02114	Ferroxcube Corp. of America Saugerties, New York
02660	Amphenol-Borg Elect. Corp. Broadview, Illinois
02735	Radio Corp. of America Semiconductor & Materials Div. Somerville, New Jersey
04062	Elmenco Products Co. New York, New York
04713	Motorola Inc. Semiconductor Products Div. Phoenix, Arizona
07263	Fairchild Camera & Inst. Corp. Semiconductor Div. Mountain View, California
07910	Continental Device Corp. Hawthorne, California
09214	General Electric Co. Semiconductor Products Dep't. Auburn, New York
09353	C and K Componants Inc. Newton, Massachusetts
11711	General Instruments Inc. Semiconductor Div. Newark, New Jersey
12674	Syncro Corp. Hicksville, Ohio
12954	Dickson Electronics Corp. Scottsdale, Arizona
14298	American Components Inc. Conshohocken, Pennsylvania
18324	Signetics Corp. Sunnyvale, California
24931	Specialty Connector Co. Inc. Indianapolis, Indiana
25088	Siemens America Corp. Iselin, New Jersey
27014	National Semiconductor Corp. Santa Clara, California
27556	IMB Electronic Products Santa Fe Springs, California
28480	Hewlett-Packard Co. Palo Alto, California
28821	Wavetek Microwave, Inc. Sunnyvale, California
56289	Sprague Electric Co. North Adams, Massachusetts
71034	Bliley Electric Co. Erie, Pennsylvania
70903	Belden Mfg. Co. Chicago, Illinois
71400	Bussman Mfg. Div. of McGraw-Edison Co. St. Louis, Missouri
71450	CTS Corp. Elkhart, Indiana
72982	Erie Tech. Products Inc. Erie, Pennsylvania
73138	Beckman Instruments Inc. Helipot Division Fullerton, California

74970	E. F. Johnson Co. Waseca, Minnesota
75915	Littlefuse Inc. Des Plaines, Illinois
76854	Oak Mfg. Co. Crystal Lake, Illinois
76493	J. W. Miller Company Compton, Calif.
76541	Monsanto Commercial Products Co. Cupertino, Calif.
79727	Continental-Wirt Electronics Corp. Philadelphia, Pa.
82389	Switchcraft Inc. Chicago, Illinois
83594	Burroughs Corp. Electronic Components Div. Plainfield, New Jersey
84171	Arco Electronics Inc. Great Neck, New York
90634	Gulton Industries Inc. Metuchen, New Jersey
91418	Radio Materials Co. Chicago, Illinois
91637	Dale Electronics Inc. Columbus, Nebraska
91929	Honeywell Inc. Microswitch Div. Freeport, Illinois
94144	Raytheon Co. Components Div. Quincy, Massachusetts
99800	Delavan Electronics Corp. East Aurora, New York.

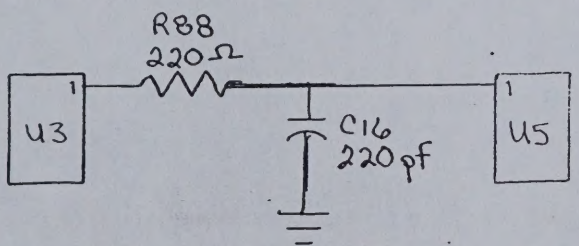
ADDITIONAL FEDERAL SUPPLY CODE FOR MANUFACTURERS

07126	Digitran Co. Pasadena, Calif.
14433	ITT Semiconductors A Division West Palm Beach, Fla.
16170	Teledyne System Co. Microelectronics Div. Los Angeles, Calif.
17856	Siliconix Santa Clara, Calif.
19447	Electro-Technique Inc. Oceanside, Calif.
22045	Jordan Electric Co. Van Nuys, Calif.
22526	Berg Electronics Corp. York Expressway New Cumberland, Pa.
31918	International Electro Exchange Inc. Eden Prairie, Mn.
32284	Rotron Manufacturing Co. Inc. Woodstock, New York
71590	Centralab Electronics Milwaukee, Wisconsin
81095	Traid Transformer Corp. Venice, Calif.
81483	International Rectifier Corp. El Segundo, Calif.
83186	Victory Engineering Corp. Springfield, N.J.
83330	H.H. Smith, Inc. Brooklyn, New York
83701	Electronic Devices Inc. Yonkers, New York
91802	Industrial Devices Inc. Edgewater, N.J.
95146	Alco Electronics Lawrence, Mass.
99392	STM Corp. Oakland, Calif.
80031	Mepco/Electra Morristown, N.J.
31223	Microplastic, Inc. Chatsworth, Calif.
18235	KRL Electronics, Inc. Manchester, N.H.

SECTION 8

MANUAL CORRECTIONS

This section lists the corrections that must be incorporated in this manual to make it correspond to a particular instrument. The serial number of each instrument is prefixed by a code number. This code number is used to identify the applicable manual corrections for a particular instrument. When correcting this manual start with the corrections corresponding to the Code No. on the instrument. If a particular component has been changed more than one time, make only the first change encountered.

CODE NO.	CORRECTIONS	PM PART NO.	SECTION OF MANUAL AFFECTED
25	None		
26	On page 7-29, add the following below A7C15:		7
	A7C16 * Cap, cer. 220pF 20% 1oooV	10000-2	
	On page 7-31, add the following below A7R87:		
	A7R88 * Res, car flm 220Ω 5% 1/4W	10013-17	
	On SD 13343, Sheet 1 (following page 7-32), add C16 and R88 as shown below.		
			
ALL	In Section 7, SD 13526, Sheet 1, change R34:		
	FROM: 470K		
	TO: 470 Ω		
ALL	On page 7-50, delete P/N 12111 from the first column.		
27	On page 7-13, change A4C13 (Value & P/N Only) to:		
	15 pF	10001-008	
	On Schematic Diagram 13526, Sheet 2, change C13 to 15 pF (located in upper center section of the sheet)		